

See for ~~Code~~
No Room Recorder

Instruction Manual

EXEC VP-1

SECODE
ELECTRONICS

SECODE ELECTRONICS

A DIVISION OF COMMUNICATIONS INDUSTRIES, INC.

**908 DRAGON STREET • DALLAS, TEXAS 75207
214-742-7231**

INSTRUCTION MANUAL

SECODE ELECTRONICS

EXEC VP-1

TELEPHONE CONTROL HEAD

A Division of Communications Industries, Inc.
908 Dragon Street • Dallas, Texas 75207

EXEC VP-1 SPECIFICATIONS

Input Impedance:	600 ohms and 3.2-16 ohms strappable
Input Sensitivity:	100 Mv, rms. minimum
SINAD:	Better than 8 db signal to noise ratio (noise 0-3000 Hz flat power spectrum)
SACS Filter Characteristics:	
2805 Hz Tone Rejection:	25 db minimum reference to 1000 Hz (Effective system tone rejection 50 db) *
Voice Band Response:	300 to 2300 Hz, +1, -3 db
Tone Bandwidth:	55 Hz at 3 db
Signaling Tone:	Single interrupted 2805 Hz tone, 8-12 pps (standard Secode digital signaling)
Input Voltage:	13.8 $\pm$ 20%, negative ground only
Input Current:	
Standby:	110 ma, nominal (80 ma pilot lamp)
Decoding:	125 ma, nominal
Indicating Call:	190 ma, nominal
Operating Temperature:	-30 degrees C to +65 degrees C
Weight:	
Net:	4 lb., 14 oz.
Gross:	6 lb., 8 oz.
Volume: (cube)	0.4 cubic feet

*Total effective tone rejection is 50 db minimum, achieved by a 4 to 1 voice to signal modulation ratio at the base transmitter, a 6 db/octave roll-off in the mobile receiver, plus the 25 db rejection of the SACS filter in the Decoder.

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Figure 1-1. EXEC VP-1 Telephone Control Head

SECTION I

GENERAL DESCRIPTION

1.1 INTRODUCTION

This manual contains a description of the EXEC VP-1 Telephone Control Head, installation instructions and preliminary adjustments, theory of operation, maintenance

procedures and troubleshooting techniques, and a parts list. Drawings too large for inclusion in text are included in Section VII.

1.2 PHYSICAL DESCRIPTION

The EXEC VP-1 Telephone Control Head is an attractive dash-mounted telephone control head used in conjunction with FM mobile transceivers. See figure 1-1. The VP-1 replaces standard industrial 2-way radio control head functions and adds the appearance, convenience, and efficiency of a mobile telephone. The EXEC VP-1 is equipped with seven (7) channel selection switches (11 channel also available) and is compatible with radios equipped with up to seven or eleven RCC channels in either the 150 or 450 MHZ bands.

Half- or full- duplex operation is permitted as determined by the radio. EXEC VP-1 features include a simultaneous all channel signaling (SACS) decoder with vehicle horn actuation, and CALL lamp latching for unattended operation. A key operated OFF/ON switch on the unit can be used to prevent transmission by unauthorized individuals, and yet leave the radio and decoder active to receive calls.

Subscriber radio equipment types govern the choice of cable interface junction assembly used or a VP-CBL/PIK, Elco male plug kit with solder-on pin connectors is available for permanent attachment to the radio control cable.

Available extra cost options are the VP-BY busy channel privacy lock-out and duplex latching, the VP-DE Mobile Dial Encoder and the VP-CR automatic channel reverting feature. A mounting hardware kit is supplied with each unit. Several color choices are available, permitting a subscriber to select a color that is compatible with his vehicle.

The all solid-state RCC-4 SACS Decoder contained within the EXEC VP-1 has a capacity of 7.2 million 7-digit national codes and 8000 local, "short-cut", 4 digit codes. This design is compatible with the coding scheme recommended by the National Association of Radiotelephone Systems (NARS) for the RCC industry. Subscriber call numbers can be changed quickly by altering strapping on the 7-digit Selector Board, as described in Section II.

1.3 ELECTRICAL DESCRIPTION

The VP-1 consists of a basic control assembly and telephone handset with push-to-talk and push-button channel selectors, mode-selection buttons, and status lamps. Channel selectors and other operating controls are shown in figure 1-1. The RCC-4 SACS decoder, contained in the VP-1 is all solid-state, using glass-epoxy etched circuit boards and hand-wired reliable components to provide durable operation with a choice of mobile transceivers.

The unit requires 12 volts dc at approximately 110 ma (standby). Circuit elements draw only approximately 30 ma in this standby mode. The pilot lamp draws approximately 80 ma. Current increases when the CALL lamp is lit to 190 ma.

Filtering circuits in the decoder separate the tone and voice and feed the voice to the handset rendering the signaling tone pulses inaudible. The inaudible tone permits the RCC operator to optionally signal simultaneously over all available channels to achieve multi-channel access.

The decoder responds to a 4- or 7- digit code (four for

local and seven for national codes), by recognizing a series of tone pulses that are transmitted from the RCC base station to provide audible and visible notification of a call.

Section IV includes a more complete description of circuit theory and interconnections. Section VII includes schematic diagrams to support the discussion.

1.4 SEMICONDUCTORS AND LAMPS

Table 1-1 lists recommended spare parts for the EXEC VP-1 and its options. Although the unit is inherently stable and seldom requires service, these components should be maintained at the repair center in the event of a malfunction. For greater convenience and reduced down time it is also suggested that the complete plug-in RCC-4 SACS decoder assembly be stocked along with the circuit assemblies of the VP-BY and VP-CR options.

Table 1-1. Recommended Spares

DESCRIPTION	TYPE	QUANTITY
5.6 V Zener Diode	IN752A	1
Germanium Diode 80 PIV 200 ma	IN270	2
Silicon Diode	TI-55	2
10.0 V Zener Diode	IN758A	1
6.8 V Zener Diode	IN5235	1
Silicon Transistor NPN	SPS4272	4
Silicon Transistor PNP	SPS4273	4
Silicon Transistor NPN	MPS6531	2
Silicon Transistor PNP, Power	D42C3	1
Silicon Transistor NPN	2N3646	1
SCR	GEC106F	1
Lamp 14 V	IEE386	2
Transistor, Power NPN	MJE521	1

SECTION II

INSTALLATION

2.1 GENERAL

The following paragraphs provide general instructions for installing the EXEC VP-1 Telephone Control Head in a mobile radio-equipped vehicle.

The EXEC VP-1 is carefully tested, inspected, and packaged for shipment at the factory. On receipt, the unit should be carefully checked for visible and concealed shipping damage. Claims (if any), should be made immediately against the delivering carrier. Inspect the radio interface cable or junction assembly, Secode VP-CBL/(Radio), to insure that it agrees with the original order and is the correct unit to mate with the particular radio.

THE EXEC VP-1 OPERATES IN 12-VOLT, NEGATIVE-GROUND SYSTEM ONLY.

- a. Physical mounting
- b. Electrical connections
- c. Input impedance and sensitivity strapping
- d. Channel revert strapping
- e. Microphone (carbon or reluctance)
- f. Audio level and sensitivity adjustments
- g. Code strapping

2.2 PRELIMINARY CONNECTIONS

Refer to Secode Bulletin SE-352 for a list of specifications and required interface cables for matching specific commercial radios to the VP-1.

2.2.1 PHYSICAL MOUNTING

Choose a suitable mounting position in the vehicle, being sure to allow sufficient clearance for ashtrays, glove compartment panels, and other movable devices to operate freely. Using the spacer bar attached to the 4-way hinge brackets as a mounting template, punch or drill four #25 holes into the mounting surface and secure the brackets in place with the 10 x $\frac{5}{8}$ " self-threading screws provided. When these are secured, the spacer bar can be discarded. Fish the mating cable from the radio set into the area of the VP-1 but do not apply power to the VP-1 until the electrical installation instructions have been observed.

2.2.2 ELECTRICAL CONNECTIONS

CAUTION

THE EXEC VP-1 OPERATES IN 12-VOLT, NEGATIVE-GROUND SYSTEMS ONLY.

The EXEC VP-1 is a standard mobile telephone control head designed to fit most 2-way radios. Individual circuit variations required by the interconnection of the control head to each radio are accommodated in the particular cable or junction assembly design. Certain minor modifica-

tions may still be required. Detailed modification instructions for each radio model and type (where required) are contained in the instructions accompanying each interface cable or junction assembly, SIM VP-CBL/(Radio).

In addition, the cable instructions state the required microphone type, correct input impedance, and reference the Volume and Squelch control values used by each radio.

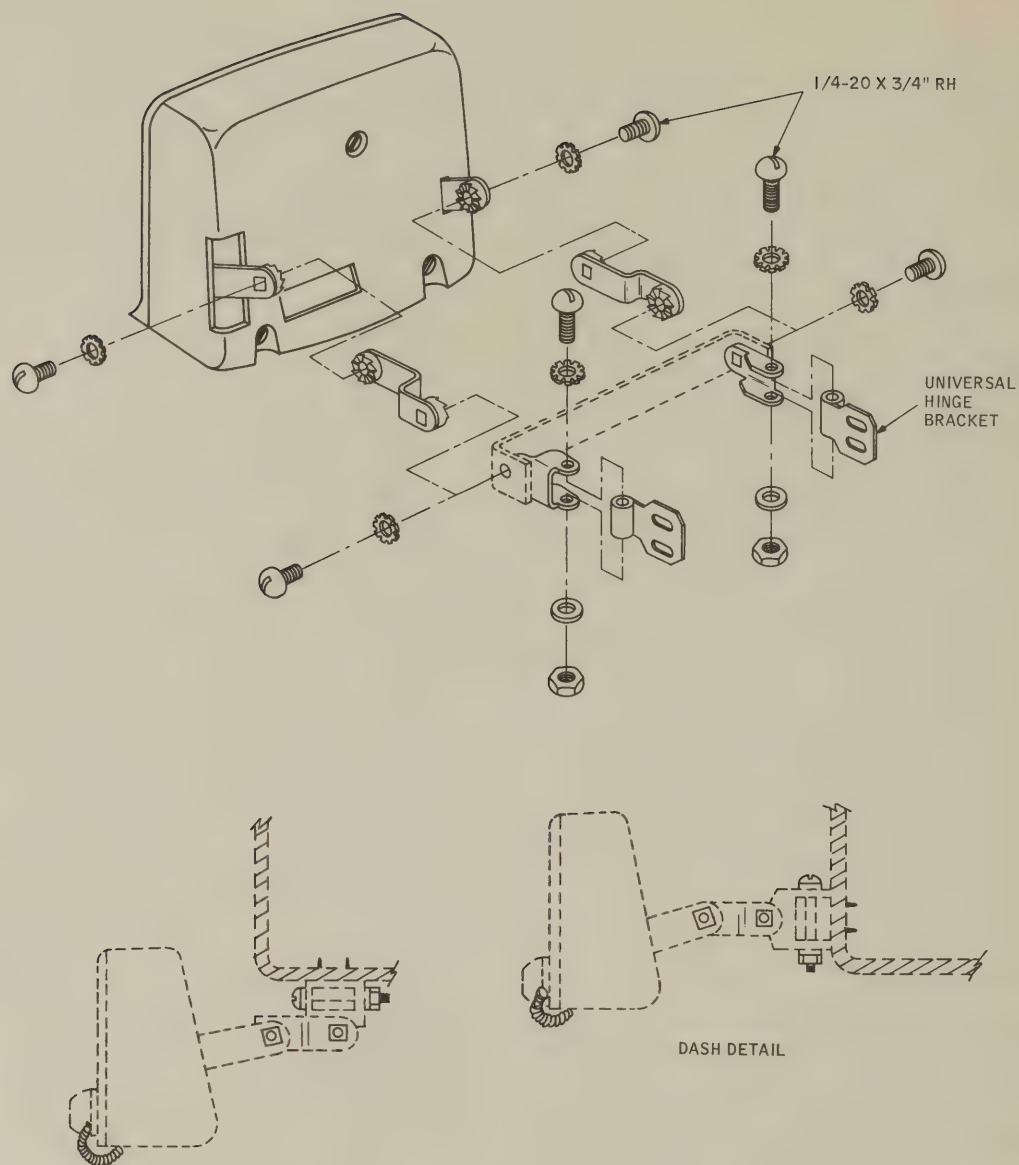
Note

The 25K-ohm value of Volume control R1 and Squelch control R2 was selected as an optimum universal value suited to the greatest number of radios. Certain specific radios may require the replacement of R1 and R2 with potentiometers of a different value. Refer to the instructions accompanying the appropriate interface cable or junction assembly for your radio, SIM VP-CBL/(Radio), before proceeding further with the installation or applying power. Carefully follow these directions and double check connections, because an error can result in serious damage to both the radio and telephone.

2.2.3 INPUT IMPEDANCE AND SENSITIVITY STRAPPING

The EXEC VP-1 is shipped from the factory strapped for a low (3.2-16 ohm) impedance input (strap J). Refer to the instructions furnished with the Interface Cable or Junction Assembly, SIM VP-CBL/(Radio), to determine the correct matching impedance for the radio equipment. If the radio is other than low impedance, it will be necessary to change the RCC-4 SACS Decoder impedance strapping as follows (See Secode Bulletin SE-352):

- a. Back off the EXEC VP-1's rear plastic shell by loosening the three captive screws.
- b. Remove the four 6-32 oval head screws, and lift out the RCC-4 SACS Decoder from its mounting.
- c. Unplug the entire decoder assembly, comprised of the tone and selector cards, from the control head and withdraw it. This permits access to the component side of the tone board.
- d. Strap Input Impedance as follows (see figure 2-2):
 - (1) For receiver with 600 ohms audio output (Refer to Secode Bulletin SE-352):
 - (a) Remove 10-ohm, 2-watt load resistor R6 from TB1-A to 3.
 - (b) Move strap from J to L on tone board.
 - (2) To return the EXEC-VP-1 to low input impedance:
 - (a) Move strap L to J
 - (b) Add 10-ohm, 2-watt resistor R6 across terminals A and 3 of TB1.



QUANTITY	DESCRIPTION	SECODE P/N
2	Hinge Mounting Bracket Assembly	22881-001
1	Template Spacer Assembly	22932-001
2	Mounting Bracket Extensions	23965-001
4	No. 10 x 4/8 Self-threading Screws	13864-004
4	Lock Washer, Ext. Tooth No. 10	13993-010
2	1/4-20 x 3/4 Black. Oxide RHMS	17739-312
2	1/4 Lock Washer Ext. Toothed	13993-214
2	Keys, Chicago Lock No. 2252	20790-002
7	Button Stops	23443-001
1	Button — Blanks	23317-211
1	Button Kit RCC UHF	24319-001
2	Dial Cards	13420-001

Figure 2-1. Control Head Mounting Detail and Installation Hardware.

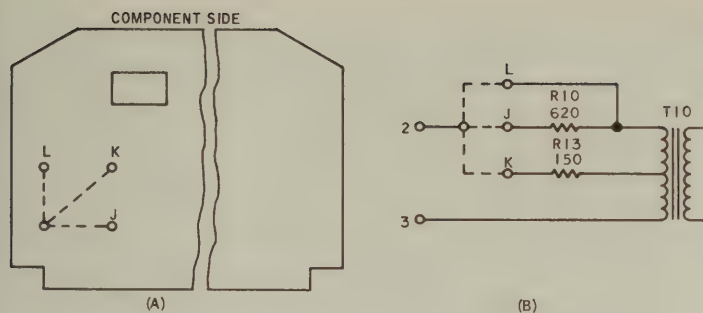


Figure 2-2. RCC-4 Impedance Strapping Detail

2.2.4 AUTOMATIC CHANNEL REVERT STRAPPING

The EXEC VP-1CR, as shipped from the factory, is strapped to revert automatically to the first (far left) channel. Automatic reverting to any one of the seven channels is possible by following these steps:

- Remove the rear cover.
- Remove the RCC-4 Decoder.
- Move the red strap from T1 (transmit channel L) to the selected channel, T 2-7.
- Move the white-red strap from R1 (receive channel 1) to the selected channel R 2-7.

Note

T and R Channels must be coincident. Do not confuse the channel's numeric sequence with the RCC channel symbol, "1" "3" "5" "7" "9", etc.

- Remove the front escutcheon by loosening the two Phillips-head screws.
- Install the button blocks provided in the installation hardware kit on those channel switches for which the radio is not crystallized, if any.
- Pull off the individual channel selector switch buttons and arrange them in the same order for which the radio is crystallized. Refer to table 2-1.

2.2.5 MICROPHONE ELEMENT

The EXEC VP-1 is supplied complete with the correct microphone cartridge to operate with the specified subscriber radio. If the radio type is not specified on the order form, a carbon cartridge is shipped as standard equipment. The installation instructions accompanying each interface cable or junction assembly, SIM VP-CBL/ (Radio), state the correct type and number of cartridge for each specific radio.

Note

Radio manufacturers often provide modification instructions and/or kits for the conversion of their radios from a reluctance to a carbon type of transmitter cartridge. Execution of this modification to standardize on carbon will facilitate future interconnection of the EXEC VP-1 within a fleet of mixed radio brands and models.

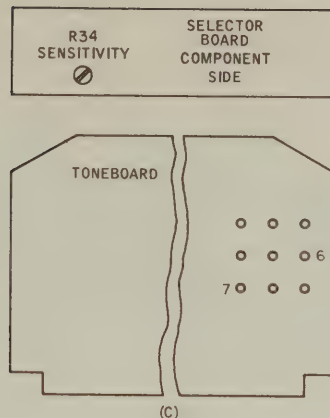


Figure 2-3. RCC-4 Level Setting Detail

2.3 INITIAL ADJUSTMENTS

2.3.1 PRELIMINARY ELECTRICAL ADJUSTMENTS

Correct signaling tone and voice levels are important for satisfactory operation of the mobile telephone. Five adjustable controls in the unit affect correct operation. These are listed below. Install the radio and cable kit according to the directions packed with the equipment.

- Volume Control — Screwdriver-adjusted potentiometer on unit's left side, viewed from front.
- Squelch Control — Screwdriver-adjusted potentiometer on unit's right-side, viewed from front.
- Sensitivity Control — Screwdriver-adjusted miniature potentiometer accessible through the top of the selector decoder board (see figure 2-3).

Note

The rear case must be removed for access to these controls.

- Handset Level Control — Screwdriver-adjusted potentiometer accessible through 1/8-inch hole in lower left corner of the front panel, under the handset.
- Dial encoder level control — Screwdriver adjusted under handset, through hole adjacent to digit 6 on dial.

2.3.1.1 RADIOS NOT HAVING EITHER VOLUME OR SQUELCH

No adjustments are required. (see 2.3.2b)

2.3.1.2 RADIOS CONTAINING VOLUME AND SQUELCH

- Turn the Handset Level Control fully on in a clockwise direction.

Note

Power should be turned off for these preliminary adjustments.

- Adjust the Volume Control potentiometer to a point approximately midway between its end points.

Table 2-1. VHF/UHF Channel Allocations

VHF FREQUENCY IN MHz			UHF FREQUENCY IN MHz		
BUTTON NUMBER	MOBILE TRANSMIT	MOBILE RECEIVE	BUTTON NUMBER	MOBILE TRANSMIT	MOBILE RECEIVE
1	158.49	152.03	21	459.025	454.025
3	158.52	152.06	22	459.05	454.05
5	158.55	152.09	23	459.075	454.075
7	158.58	152.12	24	459.10	454.10
9	158.61	152.15	25	459.125	454.125
11	158.64	152.18	26	459.15	454.15
13	158.67	152.21	27	459.175	454.175
			28	459.20	454.20
			29	459.225	454.225
			30	459.25	454.25
			31	459.275	454.275
			32	459.30	454.30
			33	459.325	454.325
			34	459.35	454.35

- c. Turn the Squelch Control fully counterclockwise for open squelch.
- d. Turn the Decoder Sensitivity Control (R34) fully off (counterclockwise).
- e. Turn the Dial Encoder Level Control fully off (counterclockwise).

2.3.2 ELECTRICAL CONNECTION AND FINAL ADJUSTMENTS

- a. Radios having adjustable volume and squelch.

- (1) Apply power to the radio.
- (2) With an RF signal generator set for the receiver input frequency and modulated with the 2805-Hz signal at 1½k Hz deviation, (sufficient RF signal to saturate limiters), adjust the Volume Control until a level of 100 mv RMS can be measured between TB1-A (audio common) and TB1-3 (audio high).

CAUTION

Continuous operation with audio levels in excess of 2 watts may overheat resistor R6 and damage surrounding components and the rear housing. Never adjust the Volume Control for greater than 2 volts of 1-k Hz at 3.3k Hz deviation across TB1-A and TB1-3 (applicable only on units equipped with low impedance audio sources).

- (3) With a 100-mv level at TB1-A and TB1-3, increase the Decoder Sensitivity Control (R34) (clockwise) until the channel BUSY lamp comes on. (The Decoder Sensitivity Control should be left at this threshold setting for normal operation.)

Note

If the VP-1 is not equipped with the VP-BY busy

circuit option, adjust the unit for 13.8 volts dc +20% across pin 7 (+battery) and pin 6 on the tone board connector.

- (4) Increase the Volume Control to produce 200 MV RMS across TB1-A and TB1-3. This is the proper setting for the Volume Control.
- (5) Reset the signal generator to provide a 1000-Hz test tone at 3.3k Hz deviation.
- (6) Adjust the Handset Level Control for a comfortable listening level in the handset.

Note

This level will normally be quite loud in comparison to normal speech levels encountered. If sufficient level cannot be obtained, repeat steps (2) through (6) with a voltage slightly higher than 100 MV in step (2).

- (7) Remove the signal from the signal generator.
- (8) Set the Squelch Control for a threshold level that is 3 db (70%) below the RF level required for 20-db receiver quieting.
- (9) Set the dial encoder tone level control to produce 1½ kHz deviation by the mobile transmitter.

- b. Level setting for use with radios not having adjustable volume and squelch.

- (1) Apply power to the radio.
- (2) Select a channel with noise present.
- (3) With noise present in the decoder, adjust the decoder sensitivity control (R34) so that the red busy lamp flickers on occasionally (10% on, 90% off duty cycle).

Note

If the VP-1 is not equipped with the VP-BY busy circuit option adjust for 13.8 volts dc ±20% across

pin 7 (+battery) and pin 6 of the tone board pin field (10% on, 90% off duty cycle).

The rear case must be removed for access to this control.

- (4) Adjust the handset level control so that the rushing sound in the earpiece is at a moderate (comfortable) level.
- (5) Set the dial encoder tone level control to produce 1½ kHz deviation by the mobile transmitter.

2.4 CODE STRAPPING

2.4.1 GENERAL

The EXEC VP-1 is shipped with the RCC-4 board strapped to detect the subscriber code 205-9551. Unit operation can be verified by having this code dialed both as 205-9551 and 9551 before proceeding further.

Careful study of the code-strapping field, readily accessible on the selector board of the RCC-4 Decoder, will reveal how codes are strapped. EIA color coded digit leads 1 through 7 are in a row also marked D1 through D7 at the base of each lead. Pulse counter pins 1 through 0 (10) are in a row parallel to the digit leads marked 1 through 0 with encircled numbers.

2.4.2 CODE STRAPPING

Restrap the unit as follows:

- a. Connect the first digit strap (marked D1 on the counter board) to the pin corresponding to the first digit of the unit's assigned code.
- b. Connect the second digit strap (marked D2) to the pin corresponding to the second digit of the unit's assigned code.
- c. Similarly connect the remaining five digits of the code in the same manner.

Note

There will be occasions when numbers in the assigned code are duplicated. A pin is provided adjacent to the origin of each digit's wire strap. This pin is electrically the same as the wire strap and the wire plug to which it is terminated; therefore, any number of duplications can be accommodated by simply connecting to the pin at the opposite end of the existing wire strap.

- d. A code length strap (black wire) is terminated to pin CL-7 and should not be changed during code strapping.

2.4.3 CODE RESTRICTIONS

- a. Do not use a digit one (1) in the first or fourth digit position of the 7-digit code number.
- b. Do not duplicate use of the first digit in the fourth digit position of the 7-digit code number. The first and fourth digits must be dissimilar.
- c. Do strap in all seven digits, even though the mobile may be intended only for local 4-digit service.

2.5 FINAL ADJUSTMENTS

- a. An additional button block and a blank button is furnished for the DPLX switch for application with half-duplex radios (radios not equipped with an antenna duplexer).

Note

Installation of the DPLX button block in radios incapable of full duplex operation is important to the successful operation of the mobile telephone. Do not omit this installation procedure.

- b. Using care to avoid scratching the front dial panel, pry loose the dial card by inserting a screwdriver under the upper edge of the chrome bezel. Neatly type or print the complete mobile code number on the card and replace the card and bezel.

SECTION III

OPERATION

3.1 GENERAL

This section contains operating instructions for the VP-1 and associated radio equipment. A study of the other sections of this manual is recommended prior to attempting operation of the unit. Additional instructions provided by the RCC operator/owner should be followed closely to avoid improper use of channel allocations or violation of FCC regulations governing mobile radiotelephone operation.

3.2 CONTROLS AND INDICATORS

Figures 1-1, 3-1, and 3-2 show the location of operating controls and lamps. Section IV discusses their electrical functions in the VP-1 circuits. Instructions for adjusting squelch, volume, and handset audio level controls are included in paragraph 2.3.1.

3.2.1 PTT SWITCH

The handset contains a PTT switch which is activated by slight finger pressure when the handset is held in the normal talk/listen position. Both the green TRANS lamp and the transmitter are activated when the PTT switch is pressed. The switch is operated in a push-to-talk/release-to-listen manner if the control head is used in conjunction with a transceiver not capable of duplex (simultaneous transmitting and receiving) operation. In a full duplex system with the VP-BY option, and the DPLX switch depressed, one momentary actuation of the PTT switch automatically places the transceiver in a transmit/receive mode. The transmitter then remains on until the handset is returned on-hook or until another channel is selected. Without the VP-BY option it is necessary to push and hold the PTT switch for full-duplex operation.

3.2.2 7-CHANNEL SELECTOR SWITCH

The channel selector pushbutton switches are electrically and mechanically interlocked so that only one channel can be selected at a time. If two or more channels are accidentally engaged at the same time, only that switch farthest to the left is electrically activated. Button stops are furnished with the installation kit to positively block selection of any channels for which the mobile radio is not equipped. The numerical order of channels is random and the channel buttons can be easily moved about to match the radio's crystalizing arrangement. The RCC vhf channels (numbers 1, 3, 5, 7, 9, 11, and 13) are normally installed on the EXEC VP-1 as shipped. The RCC uhf channel buttons (21 through 34) are supplied in the installation kit along with the button stops for any unused channels. The aluminum panel covering the buttons must be removed to exchange buttons.

3.2.3 STBY BATTERY SAVER

The STBY pushbutton is connected to circuits which prevent unauthorized transmission when the lock-switch key is turned OFF and the key is removed. In the STBY

mode, the receiver and decoder remain on and the CALL lamp latches on if a call is received. The call lamp remains on until the handset is taken off-hook.

3.2.4 HORN

The HORN button permits the vehicle horn to signal reception of a call. The horn sounds once, beginning with the end of the last pulse of the 7- or 4-digit code and ending with the reset pulse. If the number is dialed again, the horn will sound once again.

3.2.5 VOLUME, SQUELCH, AND HANDSET LEVEL CONTROLS

The level controls are screwdriver adjustments intended to be set and left at the time of installation along with the RCC-4 Decoder's input sensitivity control. Since the volume and sensitivity controls are interdependent, it is important that careful attention be paid to their adjustment during installation.

3.2.6 BUSY LAMP

The red BUSY lamp is associated with the VP-BY Busy Circuit option. When this lamp is on steady (the handset must be off-hook), it indicates the presence of 2805 Hz tone in the receiver. In this mode, no audio will be heard in the handset nor will a subscriber be able to transmit. Flickering of the busy lamp is normal with the handset off-hook in a system where the mark busy tone is not employed. Presence of 2805 Hz components in voice or in white noise is normal and will activate the busy circuit intermittently.

3.2.7 TRANS LAMP

The green transmit (TRANS) lamp is activated by the PTT switch and indicates the mobile radio is transmitting.

3.2.8 CALL LAMP

The amber CALL lamp is latched on by the decoder's receipt of a call. Reset is automatic when the handset goes off-hook.

3.2.9 KEYSWITCH AND PILOT LAMP

The keyswitch prevents unauthorized use of the transmitter while allowing the unit to receive and hold calls.

The white, circular pilot lamp (around the keyswitch) indicates the mobile equipment is on. The keyswitch and STBY pushbutton switch are connected in parallel; however, in the STBY mode, and with the key off, transmitter power is disabled.

3.3 OPERATION

The basic signaling principle employed is digital. A single 2805 Hz tone is frequency multiplexed with voice on the radio carrier and the tone is rendered inaudible in

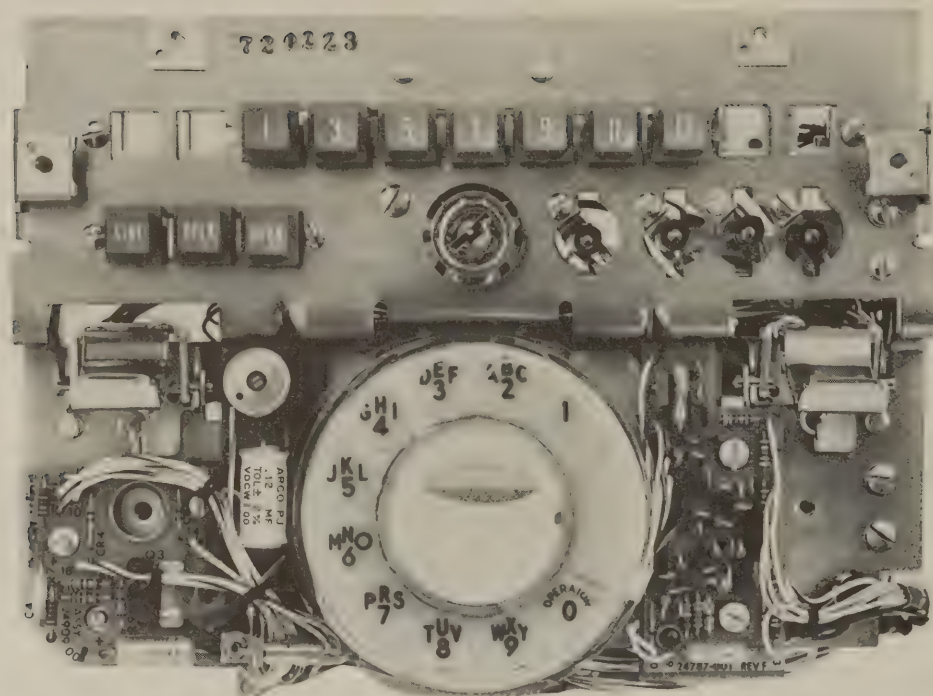


Figure 3-1. EXEC VP-1 Telephone Control Head Front View, Cover Removed, Equipped with VP-BY Busy Board and VP-DE Dial Encoder

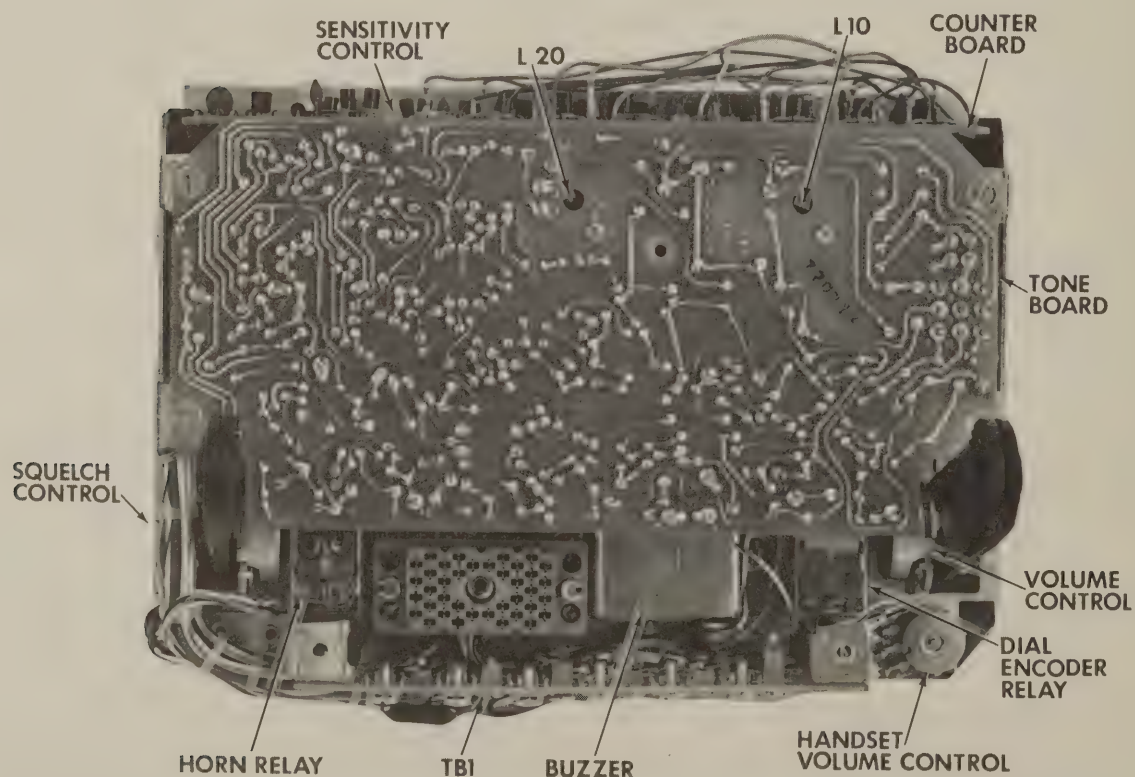


Figure 3-2. EXEC VP-1 Telephone Control Head, Rear View, Cover Removed

the handset earpiece to achieve silent signaling. Digital pulses (tone interruptions) created by the base station encoder are detected and decoded by the solid-state, RCC-4 SACS DECODER. On receipt of the correctly coded pulses and sequence of digits, the RCC-4 sounds buzzer DS-5 (and/or the vehicle horn) and latches the CALL lamp on to "leave word" of the call.

Silent signaling permits simultaneous all channel signaling (SACS) to achieve full system trunking efficiencies. It has been shown that systems utilizing the full benefits of multi-channel access offered by the SACS technique save air time, allowing more subscribers to be served over the limited available RF spectrum. Signaling can be sent simultaneously over all channels without need for subscriber monitor-channel assignments or consideration of existing channel traffic. The mobile subscriber, if called on a busy channel, (as indicated by the BUSY lamp*), manually selects an adjacent free channel to answer the call. Further signaling efficiency is achieved by eliminating the need to signal sequentially with voice traffic. With silent signaling (simultaneous signaling over voice traffic), it is possible to set up a subscriber call for immediate connection upon termination of the existing conversation. Thus, no voice channel time is wasted for signaling, ringing, and waiting for a subscriber's response.

Units equipped with the Busy Board block handset audio and prevent transmitter keying on the busy channel, provided a mark busy tone is transmitted from the base station. The silent signaling technique readily permits marking a channel busy through use of the same, frequency multiplexed, 2805 Hz signaling tone. With this option, a channel is marked busy by the presence of SACS tone after signaling is completed and the base transmitter(s) is (are) turned on. Use of the VP-BY Busy Channel Pri-

vacuity Lockout option then disables all handset functions and lights the BUSY lamp if the handset is lifted off-hook on a busy marked channel. Normal interruptions (pulses) of the continuous 2805 Hz tone for signaling purposes are of short duration and ignored by the VP-BY Busy Circuit to maintain system privacy.

The busy circuit is disabled by an initial momentary actuation of the PTT switch if there is no 2805-Hz tone present to permit uninterrupted operation on a clear channel.

In normal service with his local area, a subscriber is dialed by only the last four digits of his seven digit national RCC number. When roaming out of his local area, use of the full 7-digit identifier will distinguish him from a local subscriber that may have the same last four digits. If a roaming mobile has the same last four digits assigned as that of a local subscriber, it will then be necessary to signal both mobiles by their respective national numbers.

The Secode EXEC VP-1BY ('BY' designates inclusion of the VP-BY Busy Circuit Option) permits full-duplex operation without continuous actuation of the PTT switch if the associated mobile radio is duplexed, momentary actuation of the handset PTT switch locks on the mobile transmitter until either another channel is selected or the handset is returned on-hook. The DPLX pushbutton disables full-duplex mobile operation as required during mobile-to-mobile conversations when the connection is made on a single channel basis. A blank button and button stop is furnished with the installation kit to disable the full duplex feature when the associated mobile radio is incapable of this mode of operation. Full duplex operation of a mobile set that is not equipped with the VP-BY option requires that the subscriber hold down the PTT key in the handset continuously throughout the call.

*On VP-1 units equipped with the VP-BY option.

SECTION IV

CIRCUIT THEORY

4.1 GENERAL

This section provides circuit electrical descriptions and theory for the VP-1.

4.2 OVERALL CIRCUIT DESCRIPTION

The EXEC VP-1 contains solid-state 2805 Hz signaling tone detection circuits, operating controls and lamps, a signaling buzzer, and optional circuits. The circuit boards, including options are:

- a. RCC-4 SACS Decoder Tone Board and 7-Digit Selector Board
- b. VP-BY Busy Board (Option)
- c. VP-CR Channel Reverting Board (Option)
- d. Channel select switch circuit board (attached directly beneath the switch rack).
- e. VP-DE mobile dial encoder (Option)

4.2.1 VP-1 CIRCUIT DESCRIPTION

The EXEC VP-1 Mobile Telephone Control Head is interconnected to the 2-way radio by an interface cable or Junction Assembly, Secode Model VP-CBL/(Radio). Specific models are available for most popular radio sets. Refer to the data furnished with the applicable VP-CBL assembly for directions on its use and service. Refer to Section II.

All electrical connections to the EXEC VP-1 are made through 38-pin connector J1. See figure 7-1. Primary power is switched to the radio for both transmitter and receiver operation through ON/OFF key-switch S1. In the OFF position, the receiver can be left in a standby mode ready for calls, but at a minimum current drain, by actuation of STBY switch S2. Pilot lamp (OFF/ON) lamp DS1 is turned on by the action of either switch.

Volume Control R1 and Squelch Control R2 duplicate the functions of the controls replaced in the radio's standard control head. The value of these controls (25,000 ohms) was chosen as a happy medium to accommodate the majority of popular radios without noticeable degradation in their audio characteristics. Certain specific radio models may require the replacement of one or both of the controls as dictated by their circuit peculiarities.

Channels are selected through sequentially interlocked pushbutton switch (S6), comprised of seven individual 4-pole, double throw switches (four form C contacts). One of the DPDT banks in each switch is used to switch the receive and the transmit oscillator circuits providing separate dry contact outputs for each function. The applicable battery or ground reference voltages for each specific radio are applied to the VP-CBL/(Radio) Cable or Junction Assembly by the use of appropriate jumpers. The transmit and receive DPDT banks are series connected from switch to switch to provide an electrical interlock that blocks the simultaneous activation of multiple channels in the event

two or more switches are inadvertently pushed at the same time.

A third DPDT switch bank of S6 is used to unkey the transmitter when another channel is selected in a full-duplex mobile, thus forcing proper channel monitoring. This precaution prevents disruption of traffic on a busy channel by the mobile transmitter of a subscriber who is looking for an idle channel in a system that does not mark the channel busy with the SACS tone. Button blocks are available for any channel which might not be in use.

DPLX switch S4 applies negative battery to terminal 7 of the VP-BY Busy Circuit board, enabling this circuit to latch on the transmitter of an associated full-duplex transceiver. Without the VP-BY option, full-duplex operation can be achieved by holding down the PTT switch in the handset regardless of the DPLX switch position. With the VP-BY option, a momentary actuation of the PTT is all that is needed to latch on the mobile transmitter.

HORN switch S3 applies negative battery to pin F of J1 through the contacts of relay K1. K1 is energized by a voltage which appears on receipt of the correct code through the RCC-4 SACS Decoder and is held energized by the presence of tone following the code sequence (normally for a period of 2 to 4 seconds). Relay K1 also applies negative battery to buzzer DS5, providing a 2- to 4- second audible buzz.

Hookswitches S5-A and S5-B are mechanically actuated by the handset retention clamps and the associated latch bar assembly. Positive battery is removed from PTT switch S8 (transmitter keying), DPLX Switch S4, and CALL lamp DS4 by switch S5-B. Switch S5-B completes the handset audio circuit to battery ground from pin 4 of decoder connector J2.

Resistors R3, R4, and R5 form a network that enables adjustment of the handset receiver audio without changing the overall impedance. It is important that the output impedance of the SACS filter remain close to 600 ohms so that efficiency is maintained.

Busy light DS2 is lighted by the VP-BY busy circuit when the circuit switches negative battery to terminal 10. Terminal 10 becomes negative when: the handset is lifted from its cradle, there is a SACS tone present, and the PTT switch has not been pressed. In order for the PTT and the handset receiver audio circuits to be completed without the VP-BY, at the factory, the gray and orange wires are connected for completion of the PTT circuit and the blue-white and blue are connected to complete the audio circuit. The PTT switch also completes the circuit that lights transmit lamp DS3.

Resistor R6 is located between terminals A and 3 of TB-1 and alters the VP-1 input impedance to match low radio audio output impedances. Resistor R6 is removed when the VP-1 is used with a transceiver having a 600 ohm output impedance. Detailed information is supplied in paragraph 2.2.3.

The VP-CR Channel Reverting board mechanically actuates switch S6 contacts (through solenoid K2) when the handset is recradled. This action returns the unit automatically to a predetermined monitor channel.

4.2.2 RCC-4 SACS TONE DETECTOR

The RCC-4 SACS tone Decoder and 7-Digit Selector Boards feature solid-state design, including 67 silicon transistors. A silicon controlled rectifier (SCR) is used to latch on the CALL lamp. Codes can readily be set in minutes without soldering by repositioning the plug-in code strapping wires. Field service and bench testing of the RCC-4 SACS Decoder is made easy by the plug interconnection to the EXEC VP-1.

The RCC-4 boards recognize 2805 Hz tone presence and detect numerical codes (4- or 7-digit) by detecting mark-space relationships in the pulse trains and setting a ring counter to provide the multiple-digit readout required for signaling.

When the correct code is detected a series of gates enable buzzer DS-5, the CALL lamp, and (if the HORN button is depressed) the vehicle horn. The horn and buzzer stop at the end of the 4- or 7-digit pulse train (on reset). See figures 7-1 through 7-4. Paragraphs 4.3.1 and 4.3.2 provide description.

4.2.3 VP-BY BUSY BOARD (Option)

EXEC VP-1 units equipped with the VP-BY Busy Board provide privacy lockout and transmitter control functions. The busy board detects presence of mark busy tone (2805 Hz) transmitted by the base station when a channel is in use. The busy board also blocks audio to the handset and disables the transmitter keying circuits, preventing transmission on a busy channel. A subscriber can be called on a busy channel, but must select an open channel to answer the call. Proper busy circuit operation depends on continuous transmission of the mark busy signal from the base station. The busy circuit "disregards" short-duration signaling pulses and maintains audio blocking and transmitter keying blocking until the busy channel is cleared (2805 Hz tone absent on channel). The BUSY lamp normally flickers intermittently in the absence of tone, due to presence of 2805 Hz components in the white noise on channel. Refer to paragraph 4.3.3 and see figures 1-1 and 7-6.

4.2.4 VP-CR CHANNEL REVERTING BOARD (Option)

The VP-CR Channel Reverting board option contains a network which automatically returns the unit to a predetermined monitor ("call") channel when the handset is returned to its cradle. Refer to paragraph 4.3.4 and see figure 7-5.

4.2.5 VP-DE DIAL ENCODER (Option)

The VP-DE Dial Encoder option contains a 2805 Hz oscillator board and a manual dial. Refer to 4.3.5 and figure 7-7.

4.3 DETAILED CIRCUIT DESCRIPTION

4.3.1 OVERALL CIRCUIT ANALYSIS

The heart of the VP-1 is the RCC-4 SACS Decoder assembly. It is essentially a tone receiver and an electronic selector. It is contained on two printed circuit boards referred to as the tone board and selector board. The tone board contains an input coupling transformer, SACS filter, tone detector and amplifier, dc amplifier and Schmitt Trigger. It separates voice intelligence from the dial tone and generates dc pulses in response to signaling tone pulses.

As shown in figure 4-1, it is the absence of tone, after the presence of tone, that constitutes a pulse. The ratio between the tone-on time (38%) and the tone-off time (62%) is the conventional make-break time used with standard dial telephone systems.

A transformer couples tone and voice coming from the input terminal to a filter. The filter blocks 2805 Hz tone and passes the remaining audio frequencies to the handset. The 2805 Hz tone is coupled to an amplifier stage. Tone pulses are rectified and inverted and applied to special circuits. One circuit generates one pulse for each interruption of the 2805 Hz tone and generates an interdigit pulse when a 180 msec interdigit time is exceeded. Another generates a pulse when no tone has been detected for a 140 msec interval. The 140 msec timer (indicates end of coded message) resets the two bistable flip-flops that govern whether or not the digit counters will step. These bistable flip-flops prevent their corresponding counter (RCC and subscriber counters) to step when an incorrect digit is received. The RCC and subscriber counters are two independent counters.

The first portion of the counter contains three stages that correspond to the RCC portion of a national mobile subscriber code. The last four stages of the counter correspond to the last four digits (subscriber portion) of the 7-digit code. The first and last portion of the counter are driven separately and therefore step independently. Pulses that follow each tone interruption are coupled to an amplifier that inverts the pulses and drives the pulse counter, causing it to step from 1 through 10, depending on the number of the digits dialed. The interdigit timer, generating a pulse when there has been no tone interruption of 180 msec (indicating interdigit time), generates a pulse that is coupled to separate shift amplifiers, causing the RCC and subscriber counters to step. Leads of the RCC and subscriber digit counters, marked D1 through D7 are connected to the pulse counter. The order in which they are interconnected determines the code that will be accepted as correct by the decoder.

Because the subscriber and the RCC counters are driven by separate amplifiers, they step individually. They also register errors individually and therefore make short-cut dialing possible (dialing by the last four digits of the 7-digit call).

A number is accepted by the decoder when both the stage of the digit counter and the stage of the pulse counter that are interconnected by strapping are simultaneously turned on. For example, the second digit counter (D2) is connected by a wire strap to terminal 0 of the pulse counter, and the second digit (0) is dialed. If the second digit is 0, the digit is accepted and the counter waits for the third digit. But if the number dialed was a number other than 0, the digit counter shifts back to its first stage and the RCC flip-flop prevents further counting by its associated

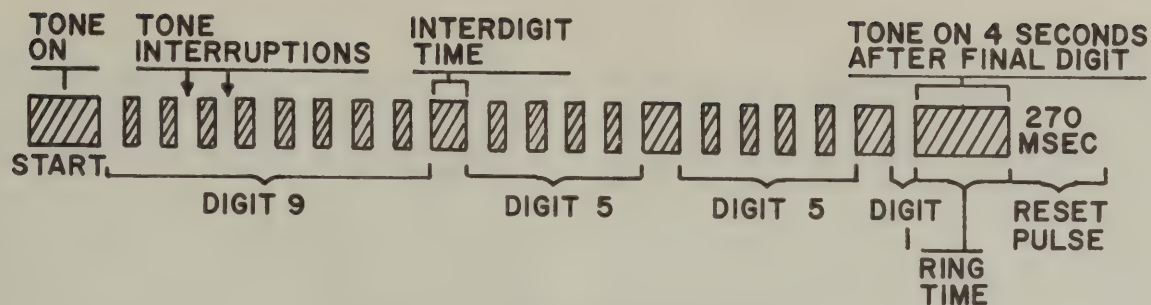


Figure 4-1. Tone Pulse Train Example

counter until its flip-flop is reset. If the RCC counter is receiving correct digits, the subscriber counter will occasionally receive incorrect digits and register a subscriber error. The error causes the subscriber counter to reset and wait for a possible fourth digit. The error causes the subscriber flip-flop to set in error state. When the third digit is received in the RCC counter, the last stage of this counter resets the subscriber flip-flop permitting the subscriber counter to step if the fourth digit is correct. For short-cut calling, the last four digits or subscriber call could be used and the RCC counter would register an error. It will not step while the subscriber counter is registering the last four correct digits. In either case, by dialing a 4- to 7-digit code, when the last digit of the subscriber counter is reached and there has been no error in the last subscriber digit (causing the subscriber flip-flop to prevent counter stepping), the last stage of the subscriber counter will couple a pulse to an AND gate that senses for correct seventh digit or the presence of error. If no error was present in the subscriber counter and the last digit was correct, the 180 msec timer pulses and the AND gate triggers a transistor switch and an SCR switch which provide the required audible and visible call indications.

4.3.2 RCC-4 DETAILED ANALYSIS

Refer to figures 7-1 through 7-4.

4.3.2.1 Receiver to Decoder Coupling. The output of the radio receiver is coupled into the tone board circuitry via isolation transformer T10. The transformer permits use of the decoder with receivers whose audio outputs are referenced to something other than negative battery. Strapping options at the primary of T10 permit: (1) direct coupling, (2) resistance coupling to a 600 ohms source, or (3) resistive coupling to a low impedance source.

4.3.2.2 2805 Hz Tone Rejection Filter. Inductor L10 and capacitors C11, and C12 comprise an m-derived low-pass filter. The filter is designed for source and load impedance of 600 ohms, and provides approximately 29 db attenuation when properly terminated. The filter must be externally loaded with 600 ohms, ± 15 percent, between pin 1 and pin 4.

4.3.2.3 Tone Receiver. Signals at the secondary of T10 are direct-coupled to bandpass filter L20, C21, and R22. The 2805 Hz output of the filter is coupled via C31 to adjustable-gain amplifier Q30 and Q40. The voltage gain is determined by $(R43, R32)/R32$, where R32 is the sum of R32 and the unbypassed portion of R34.

The amplified 2805 Hz output of Q40 is capacitively coupled to detector Q50. The base-emitter junction of Q50

half-wave rectifies the signal while the beta of Q50 amplifies the resultant base current pulses. Each collector current pulse charges C60 via CR50 and R62. When C60 is not being charged by Q50, it discharges via CR52 and R53. The voltage of C60 is sensed and amplified by Q60 with an approximate voltage gain of 4.5. The use of CR52 tends to temperature stabilize the bias of Q60. The collector voltage of Q60, negative for tone and positive for each tone interruption, is squared by Schmitt Trigger Q70 and Q80. The trigger points are chosen near 0.5 to 0.75 battery voltage.

4.3.2.4 Tone Slow Release Timer and Inverter. Q90, Q240, and Q230 comprise a tone-slow-release timer which provides a positive voltage output whenever tone has been absent for more than 140 msec. Q90 inverts the output of the Schmitt Trigger; i.e., Q90 is saturated with each tone interruption. The negative voltage is coupled through CR91 and C240 to turn Q240 off. With Q240 off, Q230 is saturated since it receives base current via R240 and R243. Q240 will remain off approximately 140 msec after tone is no longer detected. If tone returns before the 140 msec interval elapses, Q240 again saturates, but Q230 remains saturated due to base current via R90 and R93.

The output of Q230 is fed to Q260 where its output is inverted and fed to differentiator networks C26 — R231, and CR262 — C260.

A positive output from network C26 — R231 sets, or reinforces a set condition in, both R-S flip-flops by applying a positive potential to the bases of Q180 and Q220 as tone is detected in the decoder.

Network CR262 — C260 couples a negative pulse thru R156 and CR263 to the base of Q320 which sets, or reinforces a set condition in, the subscriber counter as the slow release timer times out 100 msec after no tone is detected in the decoder.

4.3.2.5 Pulse Generator. The collector waveform of Q90 is coupled via CR90 and R101. Each negative pulse of the differentiator is coupled through CR101 to a monostable multivibrator (Q100 and Q110). A nominal 40-msec pulse is generated by the monostable multivibrator for every 2805 Hz tone interruption.

4.3.2.6 Interdigit Timer. The interdigit timer consists of an integrator and a Schmitt Trigger. The output pulses of the monostable multivibrator are coupled through CR13 to integrator C130, R132, and R133. The integrator has a fast rise time determined by R132 and C130, and a slow fall time determined primarily by R133 and C130. The output of the integrator is squared by Schmitt Trigger Q130 and Q140. Transistor Q130 is normally saturated. The first pulse of a digit group charges C130 and triggers Q140 on.

During interpulse times, C130 discharges through R133 and R134. If the interpulse time exceeds the nominal 180 msec interdigit time, Q140 is triggered off (line 3 in figure 7-4). The interdigit pulse output of Q140 and the pulse output of Q100 are applied to the counting circuits of the electronic selector.

4.3.2.7 Pulse Counter. The pulse counter consists of shift amplifier Q10 and a 10-element ring counter. The pulse counter is set to the first element, Q20 and Q30, at the start of each digit by inverting and differentiating the interdigit pulse. The output of Q240 is inverted by Q420 and differentiated by C420 and CR424. The resultant negative pulses are coupled through CR420 and the first element of the pulse counter.

The pulse counter is shifted by differentiating the output of the pulse generator and momentarily cutting off shift amplifier Q10. The pulse output of Q110 is differentiated by R10 and C10. Each resultant positive pulse shifts or advances the output; i.e., from R30 to R50 (lines 4, 5, and 6 in figure 7-4). The first shift pulse of any digit is essentially ignored, since the set pulse which occurs simultaneously has priority.

4.3.2.8 Subscriber Code Digit Counter. The subscriber digit counter consists of shift amplifier Q120 and a 4-element ring counter (Q310 through Q380).

The subscriber counter is set to the first element, Q310 and Q320, at the start of a digit if it was non-coincident with the pulse counter by inverting and differentiating the interdigit pulse. The output of Q140 is inverted by Q160 and differentiated by C152 and CR155. The resultant negative pulses are coupled through CR152 to the base of Q320. The digit counter is advanced if it was coincident with the pulse counter by momentarily cutting off shift amplifier Q120. The interdigit pulse output of Q140 is differentiated by C120 and R120. The resultant positive pulses advance the output of the counter; i.e., from R320 to R340 (lines 9 and 10 in figure 7-4).

4.3.2.9 Subscriber Code Coincidence Gate. Coincidence of the pulse counter and subscriber digit counter is detected by a 2-level diode logic network. The network consists of four 2-input AND gates and one 3-input OR gate. Assume that the first element of the digit counter is energized. The common anode voltage of CR320 and 321 will be clamped to negative battery by CR321, until the pulse counter is shifted to the element to which the cathode of CR321 is "code strapped." When this occurs, the counters are coincident; i.e., the energized elements of the pulse counter and the digit counter coincide with a preset code. With the anode of CR320 no longer clamped to negative battery, base current is supplied to Q150. During interdigit time, therefore, the collector of Q150 will remain negative preventing error set of the Q170 — Q180 flip-flop. The second digit will advance the digit counter since no set pulse is generated. If the second digit is also correct, receipt of the third digit will again advance the digit counter.

4.3.2.10 Subscriber Code Error Lockout. The collector of Q150 is normally held low by Q150 conducting or by Q160 conducting. When a code error occurs, the base drive is removed from Q150 and as soon as interdigit time expires, base drive through R151 to Q160 is removed. With both transistors cut off, the collectors go positive triggering

Q170 of the subscriber flip-flop. The base of Q150 is now held off by AND gate CR151 until the subscriber flip-flop is reset. The subscriber digit counter will now be set to the first element at the start of each digit and the counter cannot advance.

4.3.2.11 RCC Digit Counter. The RCC digit counter consists of shift amplifier Q240 and a 3-element ring counter (Q250 through Q300).

The digit counter is set to the first element, Q250 and Q260, at the start of a digit, if the pulse counter and digit counter were non-coincident by inverting and differentiating the interdigit pulse. The output of Q140 is inverted by Q220 and differentiated by C401 and CR225. The resultant negative pulses are coupled through CR221 to the first element of the digit counter.

The digit counter is advanced if the pulse counter and digit counter were coincident by differentiating interdigit pulse and momentarily cutting off shift amplifier Q240. The interdigit pulse output of Q140 is differentiated by C240 and R240. The resultant positive pulses advance the output e.g., from R260 to R280 (lines 6 and 7 in figure 7-4). If the pulse counter and digit counter were non-coincident, a shift pulse and set pulse occur simultaneously, but the set pulse again has priority.

4.3.2.12 RCC Code Coincidence Gate. Coincidence of the pulse counter and RCC digit counter is detected by a 2-level diode logic network. The network consists of three 2-input AND gates and one 3-input OR gate.

Assume that the first element of the digit counter is energized. The common anode voltage of CR260 and CR261 will be clamped to negative battery by CR261 until the pulse counter is shifted to the element to which the cathode of CR261 is "code strapped." When this occurs, the counters are coincident; i.e., the energized elements of the pulse counter and the digit counter coincide with a preset code.

With the anode of CR260 no longer clamped to negative battery, base current is supplied to Q400 (line 11 in figure 7-4). During interdigit time, therefore, the collector of Q400 will remain negative preventing error set of the Q210 — Q220 flip-flop. The second digit will advance the digit counter since no set pulse is generated. If the second digit is also correct, receipt of the third digit will again advance the digit counter.

4.3.2.13 RCC Code Error Lockout. The collector of Q400 is normally held negative by Q400 or Q220 conducting. When an error occurs, the base drive is removed from Q400 and as soon as interdigit time expires, base drive through R402 to Q220 is removed. Q400 loses its base drive due to error and, with bias to both transistors removed, the collectors go positive, triggering Q210 of the RCC flip-flop into saturation. The base of Q400 is then held off by AND gate CR210 until the flip-flop resets. Post-error stepping is thereby prevented.

When an error causes positive bias to be removed from Q400, Q400 stops conducting and allows Q220 to turn off. C401 then discharges. When the next pulse comes from interdigit time to Q220, which is off, Q220 conducts. C401 charges through CR221 and R262 through the base of Q260, biasing it on and resetting the counter.

4.3.2.14 RCC Code Output. If the first three digits received are coincident with the pre-strapped code, the RCC digit counter will have advanced to the third element, the collector of Q400 will be negative. During interdigit time Darlington transistors Q190 and Q200 saturate and discharge C190.

At the start of the fourth digit, the RCC digit counter shifts to the first element, cutting off Q190 and Q200. Capacitor C190 charges via R190 and CR181 triggering Q180 into saturation. The subscriber code error lockout is then reset.

4.3.2.15 Call Outputs. A positive signal is coupled to R412 when the last element of the subscriber digit counter is energized. Diode AND gate CR410 and R412 prevents base drive to Q410 until the interdigit timer removes base drive from Q420, turning it off. Transistor Q410 conducts when the interdigit timer elapses and biases Q390 into conduction. Its collector goes negative and biases Q250 into conduction and also connects pin 8 of the board pin connector to a positive source. Pin 8 is connected through a cable harness to a relay that closes buzzer or vehicle horn circuits. As soon as tone stops, the interdigit timer receives another pulse, resetting the counters, which in turn remove bias from Q410 and it then cuts off Q390 and Q250, in turn, and removes voltage from pin 8.

A latching potential is provided at pin 9 of the board pin connector to SCR250 as it fires. A positive gate potential is supplied when Q250 conducts, causing SCR250 to fire. SCR250 will continue to conduct as long as a current source is provided through pin 9 to the CALL lamp. A switch in the handset cradle removes power from the circuit and allows the SCR to turn off when the handset goes off-hook.

4.3.3 VP-BY BUSY BOARD DETAILED ANALYSIS

The busy circuit performs three functions. It controls transmit keying, audio to the earpiece of the handset, and the BUSY lamp. See figure 7-6.

AUDIO SWITCH

Audio is coupled through the Emitter Collector Base junction of Q4 and Q5. During absence of 2805 Hz tone input terminal "3" is held positive. CR1 is reversed biased and R2 biases Q1 off. R3 and R4 reverse bias CR3. R5 and R7 form a voltage divider network that biases Q3 on. Q3, R5, and R6 form a constant current network that forward biases the collector base junction of Q4 and Q5. Audio voltage variations at terminal "1" are transferred to terminal "11" as long as the base junctions of Q4 and Q5 are forward biased.

When 2805 Hz tone is detected in the decoder, terminal "3" of the busy circuit is biased negative. Unless transmitter keying has first taken place, CR2's Anode will be negative. Negative battery at terminal "3" forward biases CR1 and Q1 is biased on. When Q1 conducts, CR3 is forwarded biased, Q3 turns off removing bias to the base junctions of Q4 and Q5 and audio voltage at terminal "1" is isolated from terminal "11."

PTT CIRCUIT (Simplex Operation)

Negative battery applied to PTT terminal "8" forward biases Q10 which conducts and forward biases Q7. Q7 conducts forward biasing CR9 and supplies forward bias for Q9. Q9 conducts, forward biasing CR10 and supplies Q7 with additional bias which forms a latching circuit between Q7 and Q9. Q9's positive collector forward biases CR11 and supplies emitter voltage for Q11. Negative battery at PTT terminal "8" forward biases CR12 and forward biases Q11 through R21. Q11 conducts, switching its collector positive which supplies forward bias to keying transistor Q12. Q12 conducts and supplies ground completion for external keying.

PTT CIRCUIT (Duplex Operation)

When in duplex operation, terminal "7" is continually held negative by the duplex mode switch. This negative supply offers ready forward bias for Q11 as soon as Q11 receives emitter supply voltage. In this mode of operation one momentary closure of the PTT switch forward biases Q10 and starts the latching sequence of Q7 and Q9. Once Q7 and Q9 are in a conducting state, CR2 will be forward biased and CR1 reversed biased. Should negative biased occur at terminal "3" of the busy circuit, the negative bias will be ineffective. Q7 and Q9 will continue to conduct until Q7's negative supply is removed from its collector by switching Q8 off. Q8 is switched off by negative bias at terminal "4" or by conduction of Q6. Q6 is biased off by negative hook switch potential applied at terminal "9" of the busy circuit (handset off hook).

Keying is prevented if negative bias is supplied to terminal "3" before PTT terminal "8" is switched negative. Negative bias at terminal "3" forward biases Q1. Q1 conducts and forward biases CR8 which reverse biases CR9 and prevents the base of Q9 from receiving forward bias.

BUSY LAMP

The busy lamp receives power when Q1 and Q2 conduct. Q1 supplies forward bias through R3 to Q2, and Q2 applies negative battery to the busy lamp. Q2 also supplies control bias for Q8.

PTT DELAY

The charge and discharge time of C3 determines the rate at which Q8 will switch on and off. To switch Q8 off the discharge path for C3 is through Q2, CR4, and R9. Therefore, Q8 is switched off rapidly when terminal "3" is switched positive (absence of tone) the charge path is from terminal "4", through R11. The time required to charge C6 to Z1's zener voltage is approximately 300 MSEC. Z1 conducts when the 6.8V zener voltage is reached. When Z1 conducts its anode becomes positive and forward biases Q8. Q8 conducts and supplies negative voltage for Q7. The purpose of the delay circuit is to prevent PTT operation during the 270 msec reset pulse.

4.3.4 VP-CR CHANNEL REVERTING BOARD DETAILED ANALYSIS

See figure 7-5. Terminal (3) is connected to negative battery, (1) is connected to the handset hook switch, and (4) is connected to positive battery. The terminal of the

hookswitch that connects to terminal (1) is positive when the handset is on-hook and negative when the handset is off-hook. If the operator has been monitoring another channel, as he replaces the handset to its cradle, the hookswitch connects terminal (1) to positive battery. Capacitor C1 begins to charge and for the time it takes to charge, base drive is supplied to Q1. Transistor Q1 conducts and energizes the solenoid that is connected in its emitter circuit. The solenoid resets the channel selector button and, in so doing, causes the VP-1 channel switch rack to revert to its home channel.

4.3.5 VP-1 DIAL ENCODER OPTION DETAILED ANALYSIS

The VP-DE Option is designed to be installed in a Se-code VP-1 Control Head to allow mobile originated out-bound dialing in systems equipped for this feature. See Figure 7-7.

The operation of the encoder can be understood by reference to the schematic drawing which represents the quiescent condition of operation. Bringing the dial off normal applies battery voltage to terminal 11 of the encoder board and charges C3 through R7. At the same time, base drive is applied to Q2 and Q3 which cause Relay K2 to operate. The operation of K2 applies battery voltage through contacts 6 and 7 to the oscillator comprised of Q1, L1, C1 and associated circuitry. The tone is then coupled through the pulse contacts of the dial to terminals 12 and 13 of TB1 by means of contacts 9 and 10 of Relay K2. The operation of K2 also closes a low resistance path from terminal 11 of TB1, through contacts 12 and 13 of K2, diode CR2 to terminal 10 of TB1. This is equivalent to operating the Push-to-Talk Key for transmitter operation.

Once the dial is brought "off normal" the action mentioned previously occurs within 30 milliseconds. Signaling by tone interruptions is accomplished in the usual manner by the opening of the pulse contacts of the dial. Interdigit timing is provided by the discharge path for C3 which requires approximately 3 seconds after completion of the

last digit. As C3 discharges, a point is reached where insufficient base drive is available to keep Q2 and Q3 turned on and Relay K2 releases.

Provisions are also incorporated in the design of the encoder for an "acknowledge" feature. Upon receipt of a call, terminal 4 of K1 goes to + battery and this is connected to terminal 15 of the encoder board. When this occurs, charging current for C4 provides base drive for Q2 and Q3 which causes Relay K2 to operate. K2 will remain operated until C4 charges (approximately 100 msec.) and cause the tone to be applied to the transmitter and cause the transmitter keying as mentioned previously. An additional path for transmitter keying is provided via CR11, R11 and terminals 15 and 16 of K2 to pin 12 of the busy board if used. This allows operation of the transmitter for the acknowledge feature even though the mobile may be "busied out" in a mark busy system.

The encoder output level will be approximately 75 mv into a 100 ohm load. This level will vary depending on frequency, load impedance and dc input voltage.

The VP-1BY Dial Encoder when installed at the factory or assembled in the field is designed to operate with a *fully duplexed mobile transceiver*. A fully duplexed mobile unit with a VP-1BY Dial Encoder and the transmitter energized will transmit 100 msec of tone as an acknowledge every time the mobile unit is decoded.

If a mobile unit equipped with a VP-1BYDE is not fully duplexed, the acknowledge feature must be disabled, otherwise the transmitter will be keyed at the end of decode thereby removing mobile radio receiver voltage which will limit audible decode alert, horn or buzzer to a short burst. Disabling of the automatic acknowledge feature is accomplished by disconnecting the white/black wire at terminal 15 on the encoder pc board. On later production boards terminal 15 on the encoder pc board will be connected to the white/black wire with a short buss wire jumper. On these boards the acknowledge feature can be disabled by clipping the jumper.

SECTION V

MAINTENANCE AND TROUBLESHOOTING

5.1 GENERAL

This section contains troubleshooting information that will assist technicians in locating causes of improper VP-1 circuit operation. The technicians should be acquainted with digital, solid-state theory.

Section VII contains circuit schematic diagrams.

5.2 REQUIRED TEST EQUIPMENT

The following test equipment or equivalent is recommended:

- a. Audio Oscillator, Hewlett-Packard 200 AB
- b. Oscilloscope, Hewlett-Packard 120B

5.3 UNIT REMOVAL AND REPLACEMENT

Refer to paragraph 2.2 and see figures 2-1, 6-1, and 6-2. The EXEC VP-1 can be removed from the vehicle by performing the following steps:

- a. Remove plug J1 and the two sets of nuts and bolts that secure the VP-1 to the universal mounting bracket.
- b. Remove the three 1" machine screws that secure the back cover.
- c. Remove four retaining screws and carefully withdraw the tone board (part number 23651-001) from its position at the rear of the unit.
- d. The selector board assembly (23392-001) is inserted in card retainers at the top of the unit. It can be left in place for tests.

CAUTION

Place unit on a nonconductive surface free of metal scraps prior to testing circuits to avoid damage to semiconductors or other devices.

- e. Give the unit a close visual inspection to check for dirt accumulations, loose solder connections, or obviously broken components.

5.4 SERVICING

The procedures included in the following paragraphs have been written to provide a rapid means of checking unit performance. If a unit or section fails to perform properly, normal troubleshooting techniques should be followed to isolate the faulty component(s).

CAUTION

Replace components with components having identical functional values and tolerances. Use heat sinks

or pliers to absorb lead heat when removing semiconductors. An isolation transformer is recommended for use with soldering irons and test equipment. Use care when replacing components to avoid separation of copper foil from the glass laminate. Holes in the board should be cleared from the foil side before component leads are inserted. Use only resincore, low temperature solder for any repairs.

Section VI lists replaceable parts and illustrates their location on circuit boards. Section VII contains schematic diagrams for the circuits. Section IV provides a detailed analysis of circuit operation.

Factory tests include acceptance testing, using a Secode test fixture for more rapid testing. The following paragraphs describe tests that can be performed with available test equipment at normal RCC mobile radio repair centers.

5.5 CIRCUIT TESTS

5.5.1 RCC-4 DECODER

Due to the complexity of the tone detector circuits, the unit must be tested in a simulated operational setup. Figure 5-1 shows a recommended test setup for the unit and associated test equipment. Table 5-1 provides a sequential test with symptoms, probable causes, and checks. Refer to figures 7-1 through 7-4 for clarification of tests and figures 6-1 and 6-2 for location of components.

The following operational summary is included because these areas are normally involved in problems associated with troubleshooting the RCC-4.

- a. Each code, (4-digit or 7-digit), must be preceded by a tone interruption in excess of 180 msec to reset the decoder.
- b. Although the decoder has a dynamic range in excess of 20 db, the absolute values of this range are determined by the settings of sensitivity control R34 and the input strapping used. As shipped from the factory, the lower limit of the range is set at 100 millivolts rms; therefore, the decoder should operate with any signal level between 100 and 1000 millivolts rms.
- c. Monitoring the "repeat" pins at the base of each code strap wire does not give an indication of the state of the digit counters. The collector of the PNP or the base of the NPN of the appropriate counter element must be checked to obtain a true indication.
- d. Although no more than one output may exist from a ring counter at any given time, a condition might exist where there is no output. If, however, no output exists after resetting the decoder or dialing any digit, the subject ring counter is probably not receiving a set pulse.

5.5.2 VP-BY BUSY BOARD

The test setup shown in figure 5-1 is used again for the busy board tests. Table 5-2 provides sequential checks for the unit. See figure 7-6.

The following operational summary is included as a supplement to earlier sections.

The busy circuit option provides automatic control of transmit and receive functions in the SACS system. The circuit is compatible with non-SACS systems.

Several operating modes are described below:

5.5.2.1 Keyswitch Off, STBY On. When the VP-1 handset is off-hook (removed from its cradle), the busy circuit will turn on the BUSY lamp and silence handset audio whenever a 2805 Hz tone is present on the channel being monitored. In a SACS system, 2805 Hz tone is present when the channel is in use. In a non-SACS system, the busy LAMP will flicker if there are strong 2805 Hz components in the voice modulation.

It is not possible to transmit at any time in this configuration.

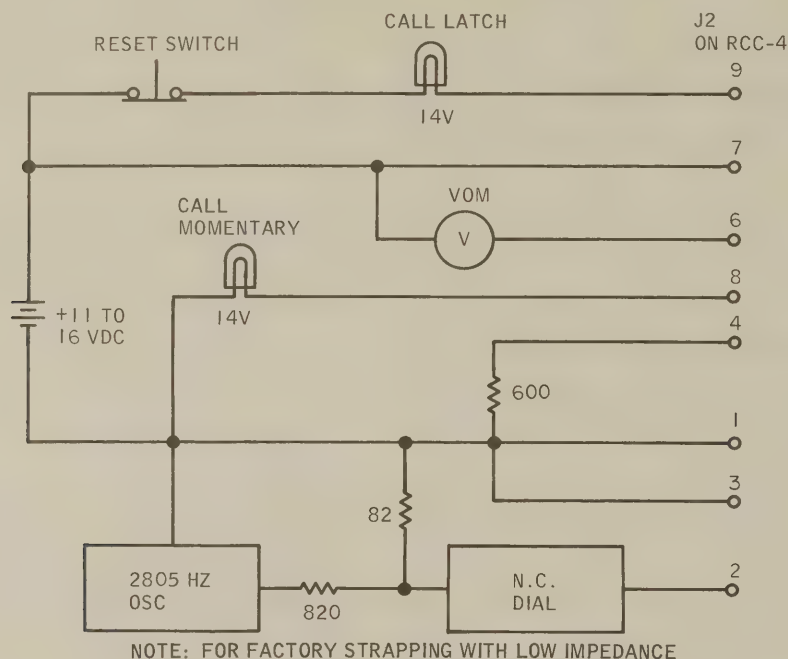


Figure 5-1. Typical Test Setup

5.5.2.2 Keyswitch On, DPLX Off. The busy circuit prevents transmitting if the handset is on-hook (in its cradle). When the handset is taken off-hook, the busy circuit will turn on the BUSY lamp, silence handset audio, and prevent transmitter operation if the 2805 Hz tone is present on the channel being monitored. If the 2805 Hz tone is not present, it is possible to transmit by depressing the handset PTT button. After transmitting once, appearance of 2805 Hz tone will not turn on the BUSY lamp or silence the handset audio, and further transmissions may be made. Changing channels or momentarily putting the handset on-hook resets the busy circuit and again prevents transmitter operation if 2805 Hz tone is present.

5.5.2.3 Keyswitch On, DPLX On. Operation is the same as with the DPLX switch off except that, after transmitting the first time, the transmitter will remain on without the necessity of keeping the handset PTT button depressed. Changing channels or putting the handset on-hook will turn the transmitter off and reset the busy circuit.

Note

When the VP-1 is used with radios not possessing full-duplex capability, the DPLX pushbutton should be blocked with a button-stop.

5.5.3 VP-CR CHANNEL REVERTING BOARD

Table 5-3 lists basic checks for channel revert option operation. For this test, the VP-1 needs +12 volts dc and ground connections connected, without other test equipment required.

The VP-1 channel revert board automatically switches the VP-1 channel selector to the user's "home" channel each time the handset is returned to its cradle (on-hook).

The channel selector may be wired to revert to any desired channel. This is done by moving jumper wires to the desired channel outputs on the circuit board directly beneath channel selector switch S6. When all the channel pushbuttons are released, the wired VP-1 will return to the desired channel for STBY monitoring.

5.5.4 VP-1 INTERNAL WIRING

If foregoing troubleshooting steps fail in locating a malfunction, again check all wiring, solder points, plug connections and terminal board strapping. Check for noisy or open potentiometers and switch contacts. Replace or repair any defective conditions, using normal repair techniques.

Table 5-1. RCC-4 Troubleshooting Chart

SYMPTOM	PROBABLE CAUSE	CHECK
1. HANDSET AUDIO		
No "HANDSET AUDIO"	No input signal	Check for proper input strapping as shown in figure 7-3.
		Check for audio input from J2-2 to J2-3.
	Output shorted	Check that the handset audio load from J2-4 to J2-1 is approximately 600 ohms.
	Faulty coupling transformer or bandstop	Check for open transformer T10 or open inductor L10.
a. Poor rejection of 2805 Hz signaling tone	Improper input strapping	Check secondary of T10 for proper impedance. Refer to paragraph 2.2.3.
	Improperly tuned filter	Check tuning of L10 for maximum rejection at 2805 Hz.
	Faulty filter	Check for faulty L10, C11, or C12.
2. TONE DETECTION		
a. Does not detect signaling tone	Improper input signal	Check for handset audio per item 1.
No "TONE" output at J2-6 (-) with respect to J2-7 (+)		Check that input signal at J2-2 to J2-3 is within 5 Hz of 2805 Hz.
		Turn sensitivity control R34 one full turn clockwise and check that input signal level is between 100 mv rms and 500 mv rms.
	Improperly tuned filter	Check tuning of L20 for maximum acceptance at 2805 Hz.
	No gain in Q30-Q40 amplifier	Check for voltage gain of approximately 80 with R34 set at maximum.
	Bad detector stage	Check for half-wave rectified sine wave at collector of Q50.
	Bad d-c amplifier stage	Check for approximate voltage gain of 4.5 at collector of Q60.
	Bad Schmitt Trigger	Check that Schmitt Trigger Q70-Q80 squares the output of Q60.
	Bad Q90 inverter	Check that Q90 inverts the output of Q80.
	Bad Q230 inverter	Check that Q230 inverts the output of Q90.

Table 5-1. RCC-4 Troubleshooting Chart (continued)

SYMPTOM	PROBABLE CAUSE	CHECK
b. Poor sensitivity	No dc power	Check for 12 vdc input at J2-7 (+) and J2-1 (-). Check for regulated 10 vdc at Q10 emitter (+) to J2-1 (-). Check for regulated 5 vdc at Q20 emitter (+) to J2-1 (-).
	Improper input signal, improperly tuned filter, or poor ac or dc gain	See item 2.a.
3. PULSE COUNTER		
a. Does not count at all.	Not detecting tone	Check for dial pulse output at Q90 collector.
	One-shot (monostable) not generating 40 msec pulses	Check for negative trigger pulse at base of Q100. Check for bad component at Q100-Q110 stages.
Appears to add successive digits	Bad shift amplifier	Check for positive shift pulses at base of Q10 shift amplifier.
	No element energizing	Check for negative set pulse at base of Q30 and faulty counter component.
b. "Hangs up" in digit other than 1 whenever a larger digit is dialed.	No set pulse being fed to pulse counter	Check for interdigit pulse at IBP-4 (+) to J2-1 (-). Check that Q420 inverts interdigit pulse output of Q140.
	Appropriate element always energized	Check for open base resistor and shorted or leaky transistors in "Hung-up" element. Check for leaky coupling capacitor at output or input of hung-element.
c. "Hangs up" in digit 1	Nth element does not de-energize with (n + 1)th pulse	Check for open coupling capacitor at output of nth element. Check for faulty (n + 1)th element.
	Only one shift pulse being received	Check for presence of more than one pulse at IBP-3 (+).
	An interdigit pulse generated for each digit	Check for presence of only one interdigit pulse for each group of dial pulses at IBP-4 (+).

Table 5-1. RCC-4 Troubleshooting Chart (continued)

SYMPTOM	PROBABLE CAUSE	CHECK
4. SUBSCRIBER DIGIT COUNTER		
a. Does not advance	No shift pulse received	Check for interdigit pulse at IBP-4 (+). Check for faulty shift amplifier Q120.
	Shift pulse swamped out by set pulse	Check that Q170 is cut-off when the decoder is reset. Check that Q150 collector remains negative when the correct subscriber digit is dialed. Check that pulse counter has registered the correct count.
b. No element energizes	No set pulse received	Check for interdigit pulse at IBP-4 (+). Check that Q160 saturates during dial pulses. Check for set pulse at IBP7.
c. Advances after incorrect digit	No set pulse received	See item 4.6. Check for open or unstrapped code wires.
	Error lockout flip-flop does not set	Check that Q150 collector returns positive when incorrect subscriber digit is dialed. Check that Q170 is saturated after incorrect subscriber digit is dialed.
d. Does not operate after correct RCC code is dialed	RCC Digit Counter not functioning	See item 5.6.
	Subscriber error flip-flop not reset	Check that Q190 is saturated when the correct 3-digit RCC code is dialed. Check that Q170 is cut off when the first subscriber digit is dialed.
5. RCC DIGIT COUNTER		
a. No element energizes	No set pulse received	Check for interdigit pulse at IBP-4 (+). Check that Q220 saturates during dial pulses. Check for set pulse at base of Q260.

Table 5-1. RCC-4 Troubleshooting Chart (continued)

SYMPTOM	PROBABLE CAUSE	CHECK
b. Does not advance	No shift pulse received	Check for interdigit pulse at IBP-4 (+). Check for faulty shift amplifier Q240.
	Shift pulse swamped out by set pulse	Check that Q210 is cut off when the decoder is reset. Check that Q400 collector remains negative when the correct RCC digit is dialed.
c. Advances after incorrect digit	No set pulse received	See item 5.a. Check for open or unstrapped code wires.
	Error lockout flip-flop does not set	Check that Q400 collector returns positive when an incorrect RCC digit is dialed. Check that Q210 is saturated when an incorrect RCC digit is dialed.
6. CALL INDICATOR		
Horn and/or buzzer cuts off prior to tone drop	Open CR1	Check for open diode (CR1) across buzzer DS5.

Table 5-2. Busy Board Troubleshooting Chart

SYMPTOM	PROBABLE CAUSE
1. Presence of 2805 Hz tone silences handset audio, but will not turn on BUSY lamp.	BUSY lamp DS2 burned out and/or transistor Q2 open.
2. Presence of 2805 Hz tone turns on BUSY lamp, but will not silence handset audio.	Transistor Q4 shorted and/or transistor Q5 shorted.
3. Presence of 2805 Hz tone will not turn on BUSY lamp or silence handset audio. (Handset off-hook and PTT not depressed)	No positive battery voltage at busy circuit RX PWR input, terminal 2. No input from decoder board. (Input terminal 3 should be approximately +0.7 VDC above negative battery, terminal 5, when tone is on. If not, check the decoder board sensitivity setting.) Hookswitch input terminal 9 not at negative battery potential. Transistor Q1 open.
4. BUSY lamp is on without a 2805 Hz tone input, but handset audio is not off.	Busy lamp output terminal 10 shorted to negative battery. Transistor Q2 shorted.
5. Handset audio is off without a 2805 Hz tone input, but BUSY lamp is not on.	Handset volume control R3 turned all the way down. No audio output from decoder board. (Check for audio between audio hi terminal 1 and negative battery with another handset.)

Table 5-2. Busy Board Troubleshooting Chart (continued)

SYMPTOM	PROBABLE CAUSE
6. BUSY lamp is on and handset audio is off without a 2805-Hz tone input.	Open wiring to handset. (Check for audio between TB1-8 and TB1-9 with another handset.) Transistor Q4 and Q5 open. False input from decoder board. (Input terminal 3 should be at positive battery voltage when checked with a VTVM. If not, check the decoder board sensitivity setting.)
7. PTT inoperative (key on, tone off).	Transistor Q1 shorted. TRANS lamp DS3 burned out.
8. TRANS lamp will not turn off.	Hookswitch input terminal 9 not at negative battery potential with handset off hook. Transistor Q7, Q8, Q9, Q10, Q11 or Q12 open.
9. PTT operative but DPLX inoperative.	Transmit output, terminal 6, shorted to negative battery. Transistor Q12 shorted.
10. PTT operates in duplex mode with DPLX pushbutton released.	DPLX input terminal 7 not at negative battery potential when DPLX pushbutton is depressed. DPLX input terminal 7 shorted to negative battery.

Table 5-3 Channel Revert Troubleshooting Chart

SYMPTOM	PROBABLE CAUSE
1. Channel revert solenoid K2 "kicks" when hookswitch lever is raised, but channel buttons do not release.	Pivot point out of position. Operate solenoid by hand and adjust pivot position so that the channel pushbuttons release when the solenoid is approximately $\frac{1}{32}$ -inch away from fully closed position.
2. Channel revert solenoid K2 does not "kick" when hookswitch lever is raised.	No battery voltage. Positive battery should be at terminal 4 and negative battery at terminal 2. No hookswitch input. Terminal 1 should have positive battery on it when on-hook; negative battery when off-hook. Solenoid K2 open. Transistor Q1 open. Check both suppression diodes and capacitor C1 before replacing Q1.
3. Channel revert solenoid K2 stays pulled in continuously.	Transistor Q1 shorted. Check both suppression diodes and capacitor C1 before replacing Q1.

Table 5-4 Mobile Dial Encoder Troubleshooting Chart

SYMPTOM	PROBABLE CAUSE
1. No 2805 Hz tone from encoder.	R4 at minimum. Transistor Q1 open.
2. Dial off normal will not key transmitter.	Key switch off. Transistor Q2 or Q3 open. Relay K2 open.

SECTION VI

PARTS LIST

SYMBOL	DESCRIPTION	SECODE PART NUMBER
EXEC VP-1 Control Head, Internal Assembly		
CR1, 3	Diode, 600, P.I.V., 1000 ma	23786-001
DS1, 2, 3, 4	Lamp, 14 Volt	24627-386
DS5	Buzzer	24798-001
K1	Relay, Horn	22706-001
MP1	Clamp, Handset Assembly	22766-001
MP2	Clamp, Spring	20786-001
MP3	Bar Assembly, Rocker	23301-001
MP4	Spring, Rocker Bar	20785-001
MP5	Miscellaneous Parts Include:	
	Screw, Escutcheon No. 6-32 X 3/8 In. Lg.	23418-008
	Mounting Hardware Kit	23442-001
	Nut, Speed	22848-001
	Escutcheons, Marked as specified	23431-TAB
	Fasteners, Captive, Front and Rear Shells	21889-001
	Dial Blank, Secode	13420-001
	Dial Card Retainer	24077-001
	Dial Card, Paper	13420-002
	Color Kit, Red	VP-CK Red
	Color Kit, Beige	VP-CK Beige
	Color Kit, White	VP-CK White
	Color Kit, Black	VP-CK Black
R1, 2	Resistor, Variable 25 k, 1 w, 20%	23177-253
R3	Resistor, Variable 1 k, 2/10 w, 30%	13430-004
R4	Resistor, 1.1 k, 1/2 w, 5%	51104-064
R5	Resistor, 910 ohm, 1/2 w, 5%	51104-062
R6	Resistor Assembly, Wirewound, 10 ohm, 3% Dale 6804N	24370-001
S1	Switch, 2 Key	20790-001
S2, 3, 4	Switch Assy S.D.H.	23355-002
S5A, B	Hookswitch, Miniature	23349-001
S6	Switch Assembly, Push Button 7 switches	23950-001
S6-1, 2, 3, 4, 5, 6, 7	Switch, Individual Replacement	23950-003
XDS1, 2, 3, 4	Socket, Lamp	24666-001
Channel Reverting Board Assembly 23990-001		
Fig. 6-3	VP-CR Channel Reverting Board	
C1	Capacitor, Tantalum 47 Mfd, 20 WVDC	13546-010
CR1	Diode, PIV-600 v	23786-001
Q1	Transistor, GE Power	25165-003
R1	Resistor, 10 k, 1/4 w, 5%	51103-087
R2	Resistor, 82 ohm, 1/4 w, 5%	51103-037
MP1	Channel Reverting Solenoid	24044-001
Tone Board Assembly 23615-001		
Fig. 6-4	RCC-4 SACS Decoder Tone Board	
C11	Capacitor, .02 Mfd PJ, 100 v	22592-203
C12	Capacitor, Poly 0.062 Mfd, 5%, 100 v	23215-623
C13, 20	Capacitor, Tant 150 Mfd, 15 WVDC	23388-157
C21	Capacitor, Poly .056 Mfd, 5%, 100 v	22592-563

SYMBOL	DESCRIPTION	SECODE PART NUMBER
Tone Board Assembly 23615-001 (continued)		
C26, 31, 90, 150, 151, 170, 190, 200, 230, 231, 232	Capacitor, .047 Mfd, Mylar, 100 v	23385-473
C30, 32, 40, 41	Capacitor, Tant 1.0 Mfd, 15 WVDC	23388-105
C42, 110	Capacitor, Tant 5.6 Mfd, 6 WVDC	23386-565
C60	Capacitor, Tant 5.6 Mfd, 15 WVDC	23388-565
C120	Capacitor, Disc 0.005 Mfd, 150 WVDC	14922-006
C130	Capacitor, Tant 22 Mfd, 6 WVDC	23386-226
C152, 260	Capacitor, Tant 0.33 Mfd, 6 WVDC	23386-334
C210	Capacitor, .047 Mfd, Disc	22489-001
C240	Capacitor, 1.5 Mfd, 6 WVDC	23386-155
C250	Capacitor, Tant 1.8 Mfd, 10%, 20 WVDC	13546-204
CR10	Diode, 1N758A	23619-100
CR20	Diode, 1N752A	23619-056
CR50, 51, 52, 53, 90, 101, 103, 150, 152, 170, 180, 181, 211, 220, 230, 261, 262, 263	Diode, 1N270	22492-001
CR91, 100, 102, 151, 155, 160, 200, 210, 231, 250, 251, 266	Diode, TW10	15104-002
L10	Inductor Assembly	23205-001
L20	Inductor Assembly 2805 Hz	23204-001
L20	Inductor Assembly 1500 Hz	23204-002
P1	Connector, Electrical 9 pin Molex	25168-009
Q10, 20, 30, 40, 60, 90, 150, 160, 170, 180, 190, 200, 210, 220, 230, 240, 260	Transistor, SPS4272	24079-210
Q50, 70, 80, 100, 110, 120, 130, 140, 250	Transistor, SPS4273	24079-110
R10	Resistor, 620 ohm, 1/4 w, 5%	51103-058
R11, 50	Resistor, 100 ohm, 1/4 w, 5%	51103-039
R12	Resistor, 220 ohm, 1/2 w, 5%	51104-047
R13	Resistor, 150 ohm, 1/4 w, 5%	51103-043
R20	Resistor, 220 ohm, 1/4 w, 5%	51103-047
R21	Resistor, 47 ohm, 1/4 w, 5%	51103-031
R22, 133	Resistor, 15 k, 1/4 w, 5%	51103-091
R30	Resistor, 11 k, 1/4 w, 5%	51103-088
R31	Resistor, 220 k, 1/4 w, 5%	51103-119
R33	Resistor, 100 k, 1/4 w, 5%	51103-111
R34	Resistor, Variable Linear taper, 25 k, Single Turn 10 Turn	24106-253 23613-253
R40, 49, 120, 140	Resistor, 6.8 k, 1/4 w, 5%	51103-083
R41	Resistor, 68 k, 1/4 w, 5%	51103-107
R42, 61, 171, 181, 211, 221	Resistor, 33 k, 1/4 w, 5%	51103-099
R43, 51, 80	Resistor, 22 k, 1/4 w, 5%	51103-095

SYMBOL	DESCRIPTION	SECODE PART NUMBER
Tone Board Assembly 23615-001 (continued)		
R52, 62, 63, 81, 103, 134, 250, 252	Resistor, 1 k, 1/4 w, 5%	51103-063
R53	Resistor, 1.5 k, 1/4 w, 5%	51103-067
R60, 110, 170, 180, 190, 210, 220, 230, 260, 261	Resistor, 4.7 k, 1/4 w, 5%	51103-079
R70	Resistor, 750 ohm, 1/4 w, 5%	51103-060
R71, 90, 91, 92, 100, 240, 251	Resistor, 10 k, 1/4 w, 5%	51103-087
R72	Resistor, 3.9 k, 1/4 w, 5%	51103-077
R93, 101, 154, 182, 212, 231, 243	Resistor, 27 k, 1/4 w, 5%	51103-097
R102, 142, 150, 153, 253, 262	Resistor, 3.3 k, 1/4 w, 5%	51103-075
R111	Resistor, 12 k, 1/4 w, 5%	51103-089
R121, 130	Resistor, 470 ohm, 1/4 w, 5%	51103-055
R131	Resistor, 1.8 k, 1/4 w, 5%	51103-069
R132, 156	Resistor, 270 ohm, 1/4 w, 5%	51103-049
R141	Resistor, 2.2 k, 1/4 w, 5%	51103-071
R151, 201, 232	Resistor, 47 k, 1/4 w, 5%	51103-103
R152, 191, 200, 241	Resistor, 120 k, 1/4 w, 5%	51103-113
R242	Resistor, 680 ohm, 1/4 w, 5%	51103-059
SCR250	Rectifier, Silicon Control GE C106F	23612-050
T10	Transformer	19406-001
Selector Assembly 23392-001		
Fig. 6-5	RCC-4 7-Digit Selector Board	
C10, 240	Capacitor, Disc 0.005 mf, 150 WVDC	14922-006
C30, 50, 70, 90, 110, 130, 150, 170, 190, 210, 260, 280, 300, 310, 320, 340, 360, 400, 410	Capacitor, Disc 0.047 mf, 10 WVDC	22489-001
C401, 420	Capacitor, Tantalum 0.33 mf, 15 WVDC	23388-334
CR20, 221, 262, 310, 400, 420	Diode IN270	22492-001
CR220, 225, 260, 261, 280, 281, 300, 301, 320, 321, 340, 341, 360, 361, 380, 381, 410, 424	Diode — TW10	15104-002
P1, 2, 3, 4, 5, 6, 7, 8	Connector, Electrical, Female	24135-003
J1, 2, 3, 4, 5, 6, 7, 8	Connector Pin	24134-001
Q10, 30, 50, 70, 90, 110, 130, 150, 170, 190, 210, 240, 260, 280, 300, 320, 340, 360, 380	Transistor — SPS4273	24079-110

SYMBOL	DESCRIPTION	SECODE PART NUMBER
Selector Assembly 23392-001 (continued)		
Q20, 40, 60, 80, 100, 120, 140, 160, 180, 200, 220, 250, 270, 290, 310, 330, 350, 370, 390, 400, 410, 420	Transistor — SPS4272	24079-210
R10, 20, 40, 60, 80, 100, 120, 140, 160, 180, 200, 240, 250, 270, 290, 310, 330, 350, 370, 421	Resistor, 6.8 k, ¼ w, 5%	51103-083
R11, 241	Resistor, 470 ohm, ¼ w, 5%	51103-055
R12, 242, 311	Resistor, 4.7 k, ¼ w, 5%	51103-079
R30, 50, 70, 90, 110, 130, 150, 170, 190, 210, 260, 280, 300, 320, 340, 360, 380	Resistor, 2.7 k, ¼ w, 5%	51103-073
R13, 261, 263, 281, 301, 302, 321, 341, 361, 381, 402, 412, 420	Resistor, Composition 47 k ohm, ¼ w, 5%	51103-103
R262, 423	Resistor, Composition 270 ohm, ¼ w, 5%	51103-049
R400, 410, 411	Resistor, Composition 120 k, ¼ w, 5%	51103-113
R401, 403, 422	Resistor, Composition 3.3 k, ¼ w, 5%	51103-075
VP-BY Busy Board Assembly 24787-001		
C1, 4	Capacitor, .047 Mfd, 10 VDC	22489-001
C2, 3	Capacitor, Tantalum 22 Mfd, 15 VDC	16939-004
C5	Capacitor, 2.2 Mfd at 20 VDC	13546-205
CR1, 4, 7, 9, 10, 11, 12	Diode, TI55	15104-002
CR2, 3, 5, 8	Diode, 1N270	22492-001
Z1	Diode, Zener 6.8 v 1N5235	24379-029
Q1, 3, 9, 10, 11	Transistor, PNP, SPS4273	24079-110
Q2	Transistor, NPN, 2N3646	24072-001
Q4, 5, 7, 8	Transistor, NPN, SPS4272	24079-210
Q6	Transistor, NPN, MPS6531	24374-002
Q12	Transistor, NPN, MJE521	24183-521
R1, 2, 4, 7, 12, 13, 15, 16, 17, 19, 20, 24	Resistor, Carbon, 10 k, ¼ w, 5%	51103-087
R3	Resistor, Carbon, 1.5 k, ¼ w, 5%	51103-067
R5	Resistor, Carbon, 3.6 k, ¼ w, 5%	51103-076
R6	Resistor, Carbon, 470 ohm, ¼ w, 5%	51103-055
R8	Resistor, Carbon, 3.3 k, ¼ w, 5%	51103-075
R9	Resistor, Carbon, 220 ohm, ¼ w, 5%	51103-047
R10	Resistor, Carbon, 22 ohm, ¼ w, 5%	51103-023
R11	Resistor, Carbon, 15 k, ¼ w, 5%	51103-091
R14	Resistor, Carbon, 3.3 k, ¼ w, 5%	51103-075
R18	Resistor, Carbon, 2.0 k, ¼ w, 5%	51103-070
R21, 22	Resistor, Carbon, 4.7 k, ¼ w, 5%	51103-079
R23	Resistor, Carbon, 680 ohm, ½ w, 5%	51104-059

SYMBOL	DESCRIPTION	SECODE PART NUMBER
VP-DE Dial Assembly 24987-001		
C1	Capacitor, .12 Mfd @ 100 VDC (2805 Hz)	22592-124
C1	Capacitor, .22 Mfd @ 100 VDC (1500 Hz)	25296-224
C2	Capacitor, .1 Mfd @ 50 VDC	23385-104
C3	Capacitor, 47 Mfd @ 20 VDC	13546-221
C4	Capacitor, 2.2 Mfd @ 20 VDC	13545-205
C5	Capacitor, .22 Mfd @ 100 VDC (1500 Hz)	25296-224
CR1, 2, 3, 4	Diode, T155	15104-002
Q1, 3	Transistor, MPS6531	24374-002
Q2	Transistor, SPS4272	24079-210
L1	Inductor, 2805 Hz	24767-001
DS1	Socket, Lamp	24666-003
E1	Lamp, GE-386	24627-386
R1	Resistor, Carbon, 100 k, 1/4 w	51103-111
R2	Resistor, Carbon, 47 k, 1/4 w	51103-103
R3	Resistor, Carbon, 200 ohm, 1/4 w (2805)	51103-046
R3	Resistor, Carbon, 39 ohm, 1/4 w (1500)	51103-029
R4	Potentiometer, 1 k, 1/4 w, 20%	24970-102
R5	Resistor, Carbon, 560 ohm, 1/4 w	51103-057
R6	Resistor, Carbon, 150 ohm, 1/4 w	51103-043
R7	Resistor, Carbon, 220 ohm, 1/4 w	51103-047
R8, 9, 10	Resistor, Carbon, 33 k, 1/4 w	51103-099
PARTS NOT ON P.C. BOARD		
K2	Relay 4C 12 v 185 ohm	13459-002
	Dial Card, Blank	13420-002
Dial	MCS 200	20871-001

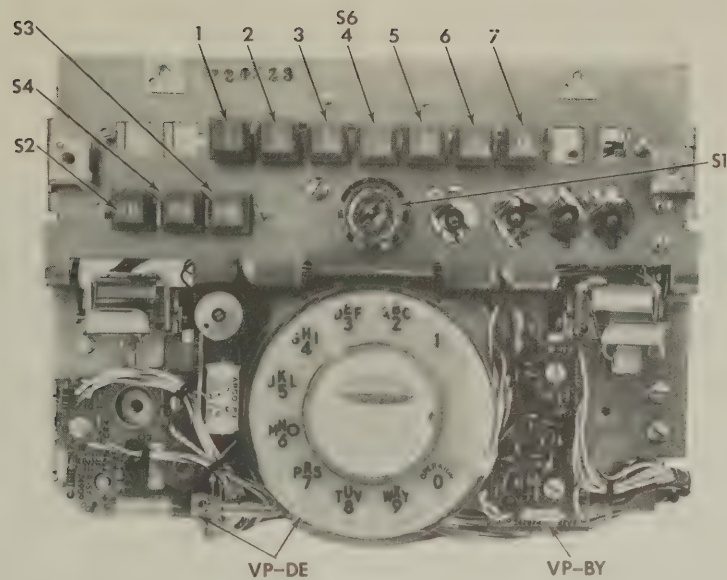


Figure 6-1. EXEC VP-1 Telephone Control Head, Front View, Cover Removed

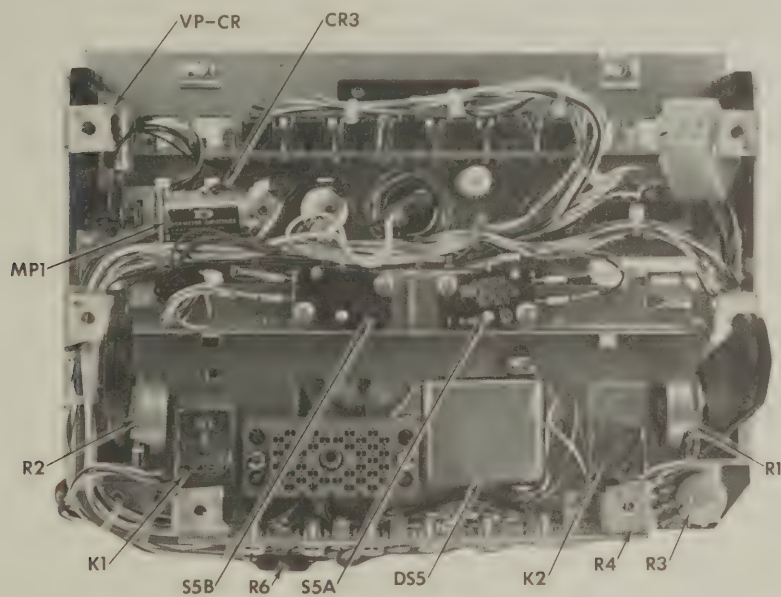


Figure 6-2. EXEC VP-1 Telephone Control, Rear View, Cover Removed

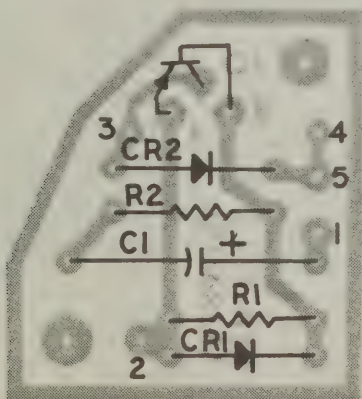


Figure 6-3. VP-CR Channel Reverting Board Assembly (23990-001)

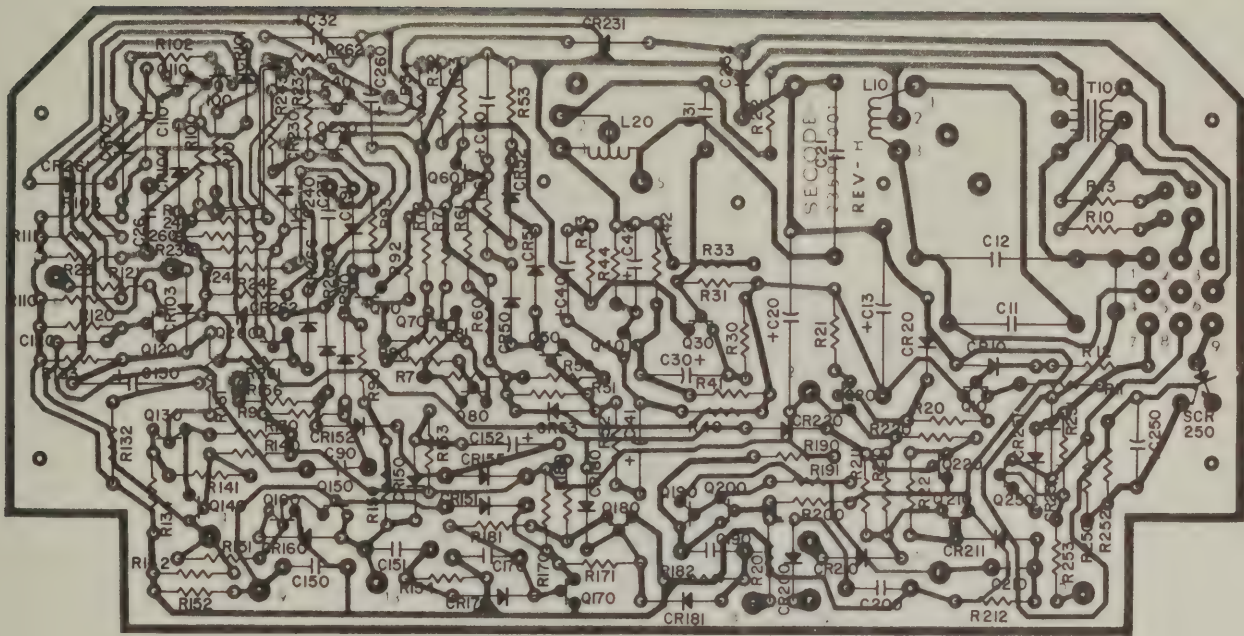


Figure 6-4. Tone Board Assembly (23615-001)

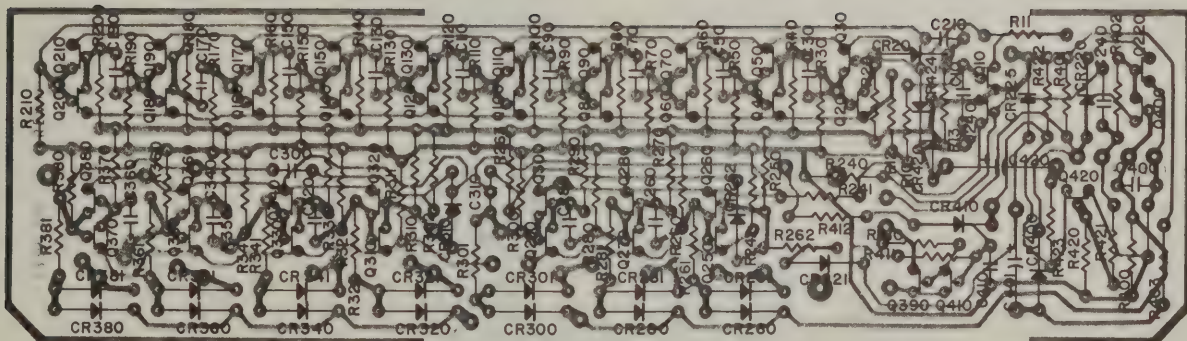


Figure 6-5. 7 Digit Selector Assembly (23392-001)

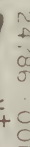


Figure 6-7. VP-DE Mobile Dial Encoder

EXEC VP-1
SECTION VII
SCHEMATIC DIAGRAMS

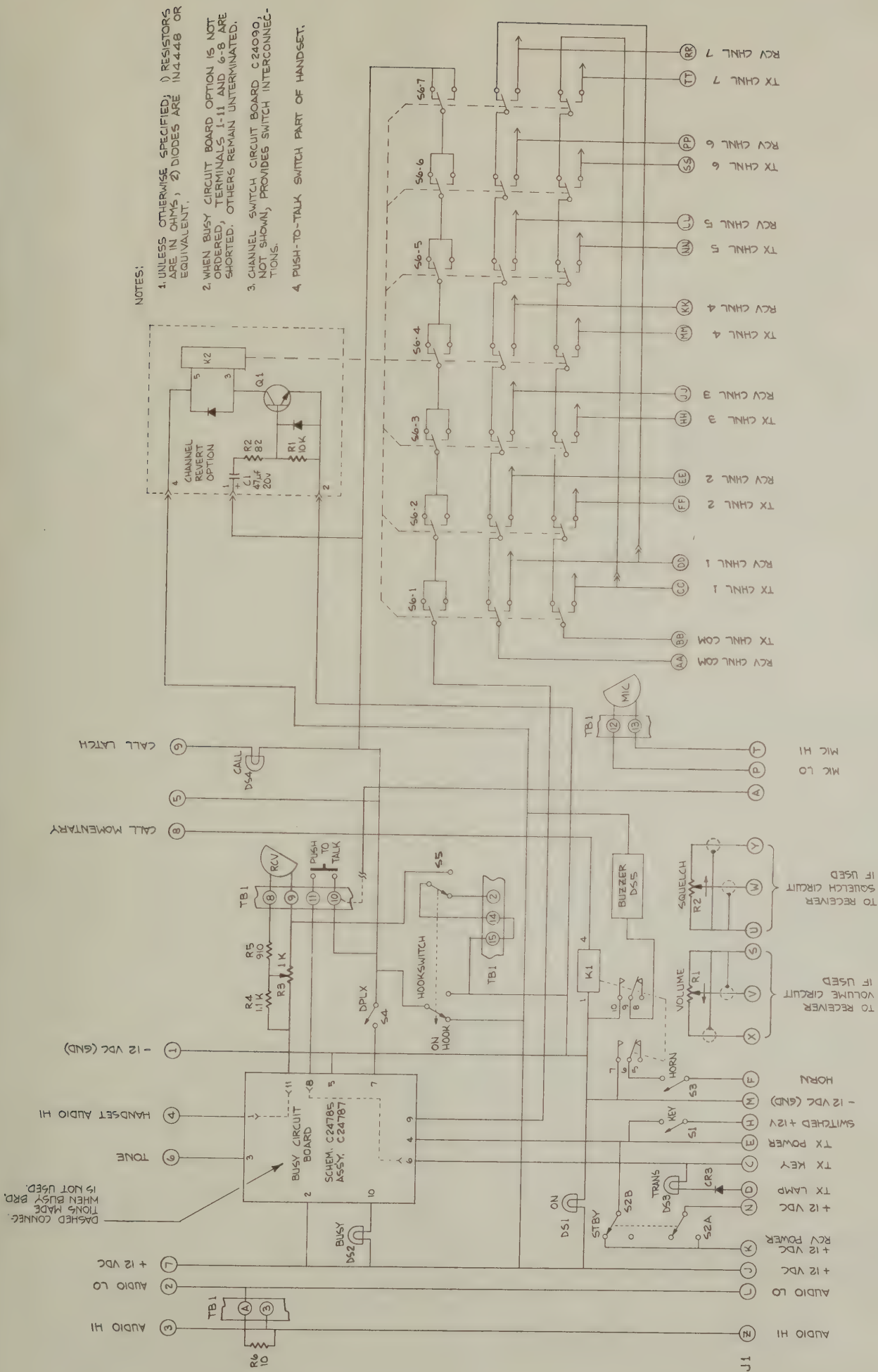


Figure 7-1. EXEC VP-1 Telephone Control Head, Schematic Diagram



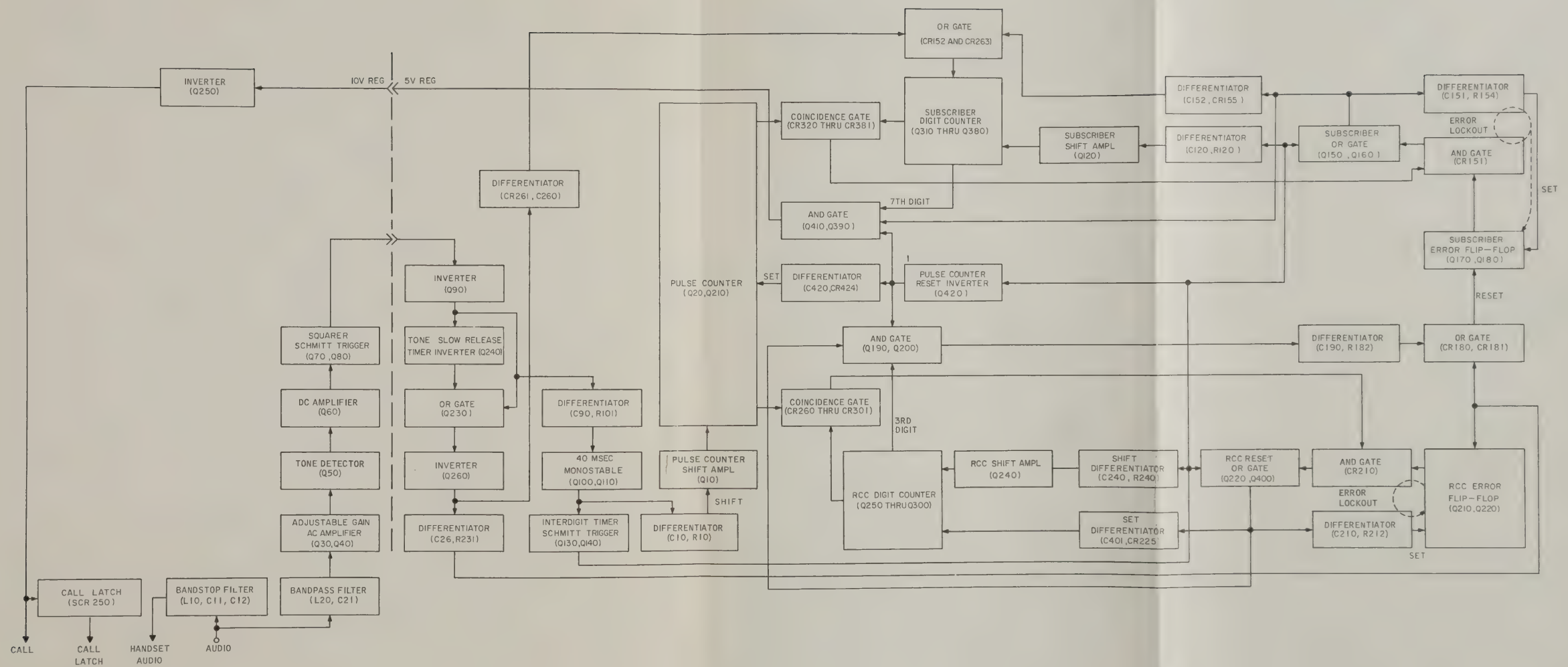
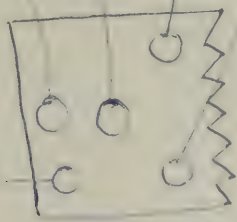


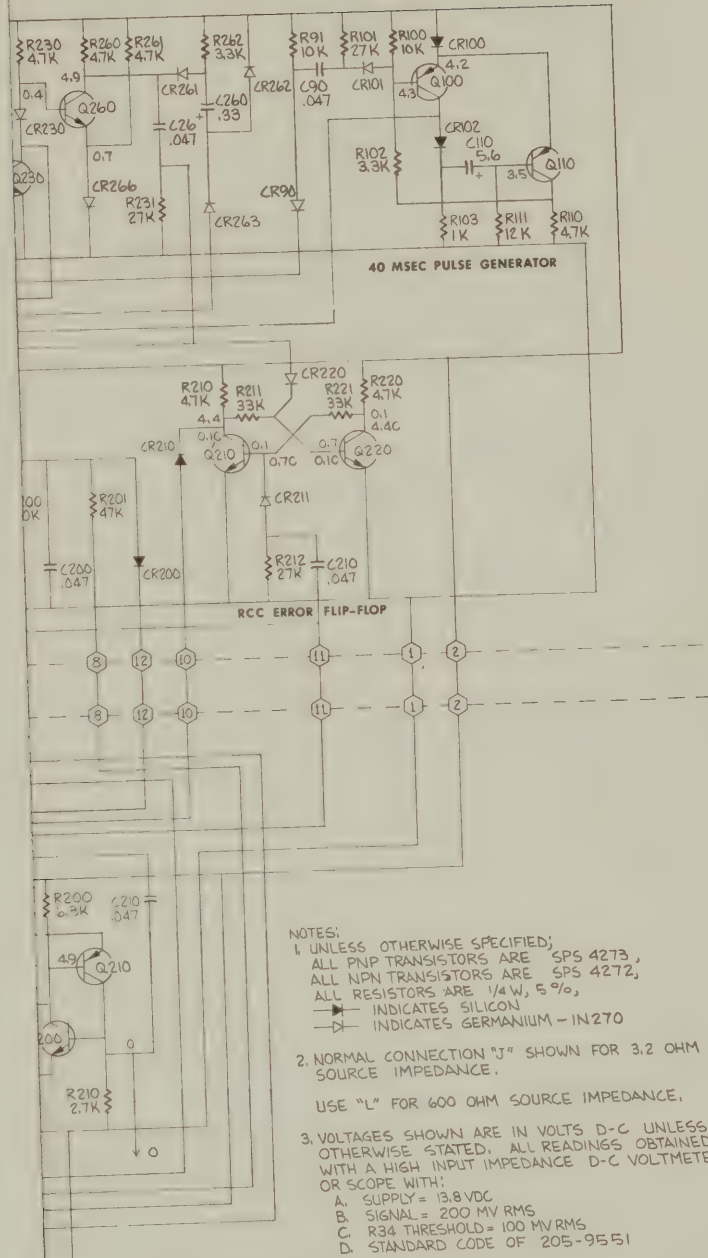
Figure 7-2. RCC-4 SACS DECODER
Functional Block Diagram

All Leads to Decoder

OR Blue Red Black Yellow



FRONT VIEW
Looking in to
pins on Motor



NO SUFFIX READINGS EXIST WHEN DECODER IS RESET BY 275 MSEC TONE INTERRUPTION.

SUFFIX "C" READINGS EXIST AFTER STD. CODE HAS BEEN RECEIVED.

Figure 7-3. SCHEMATIC, RCC-4 DECODER

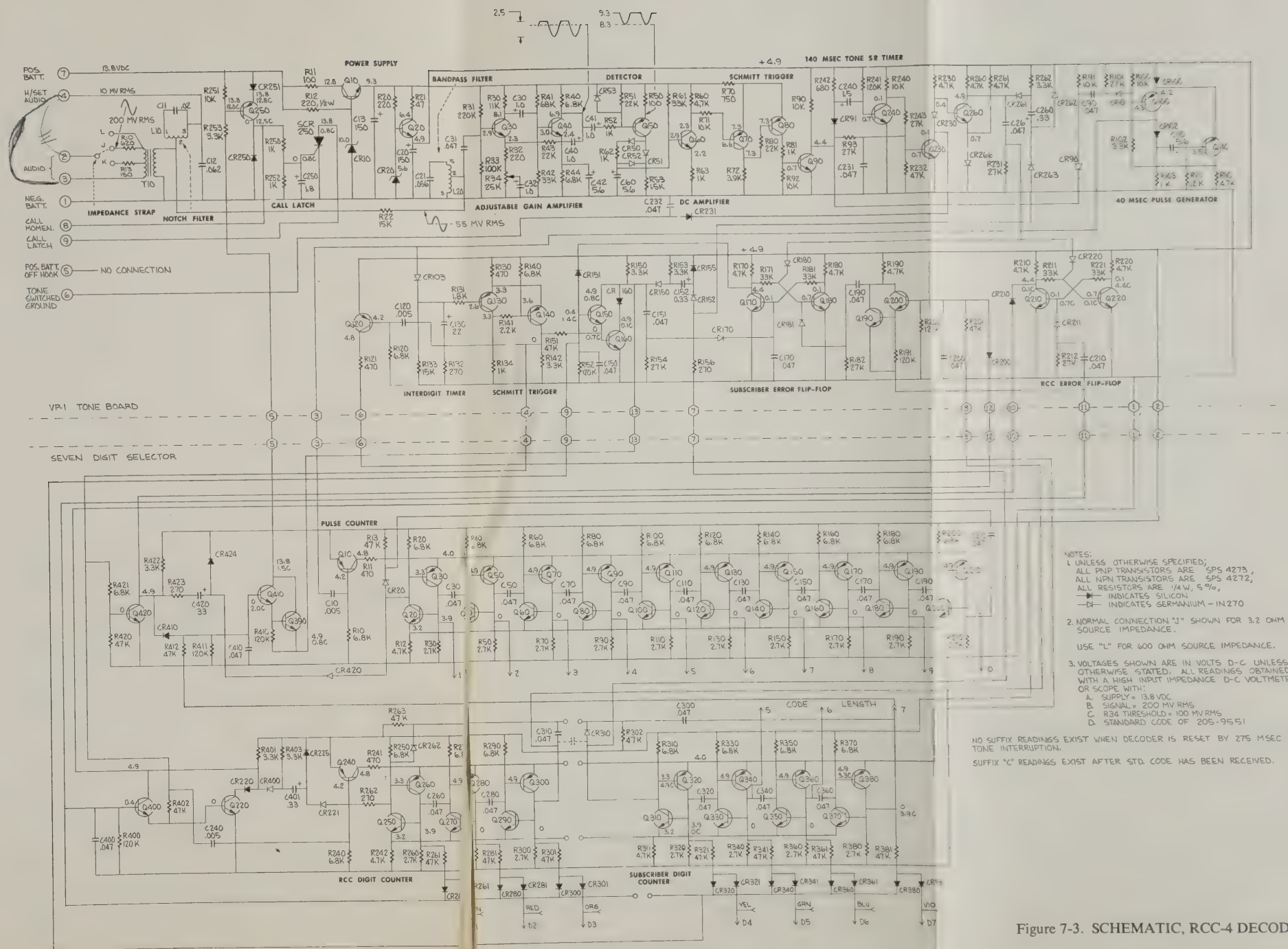
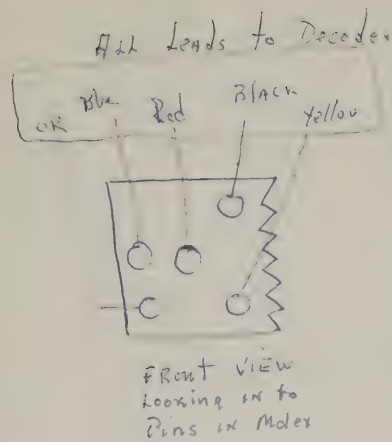
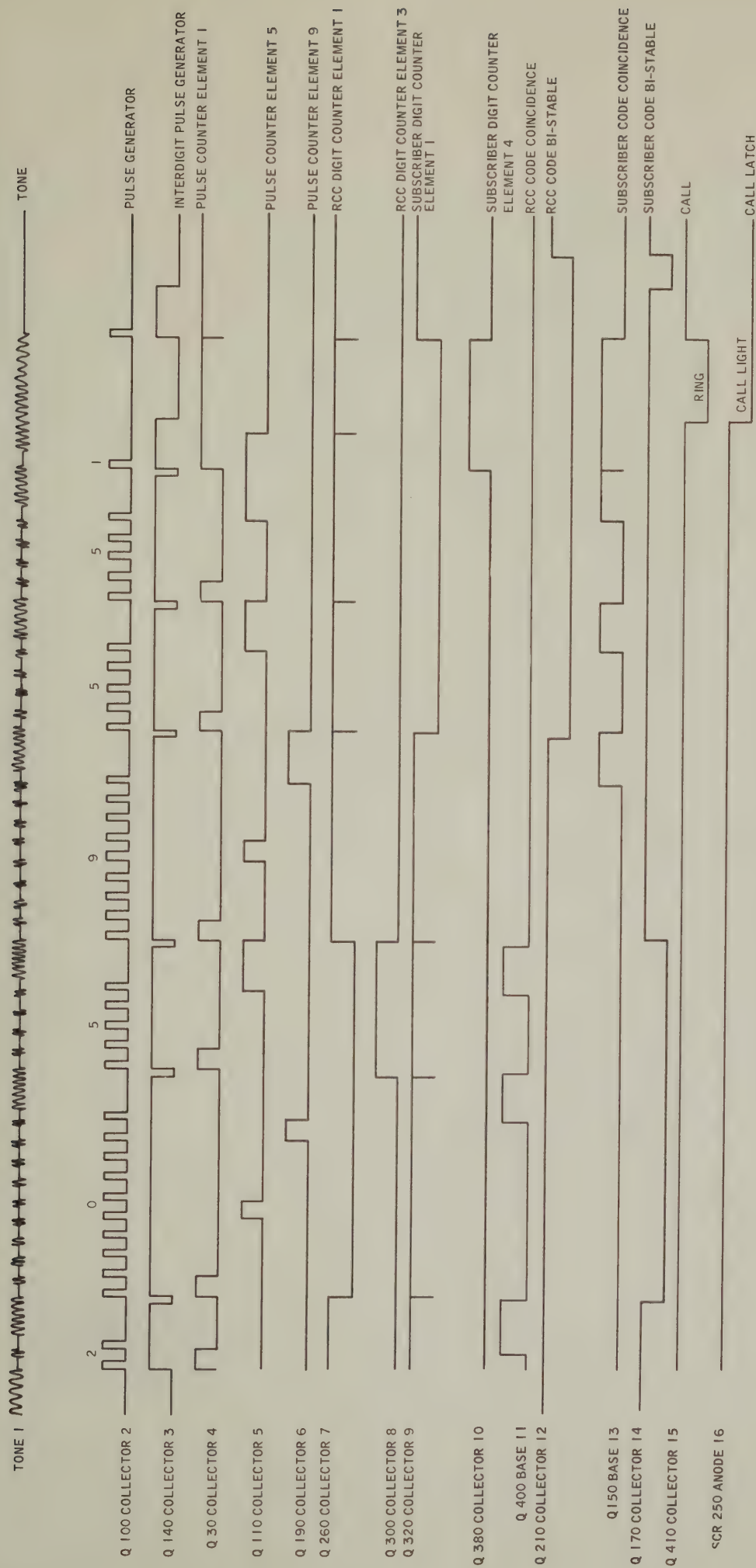
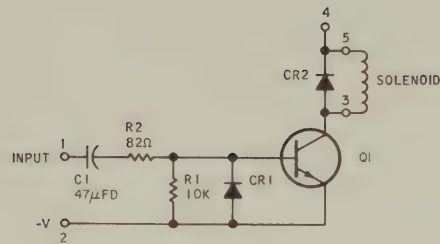


Figure 7-3. SCHEMATIC, RCC-4 DECODER



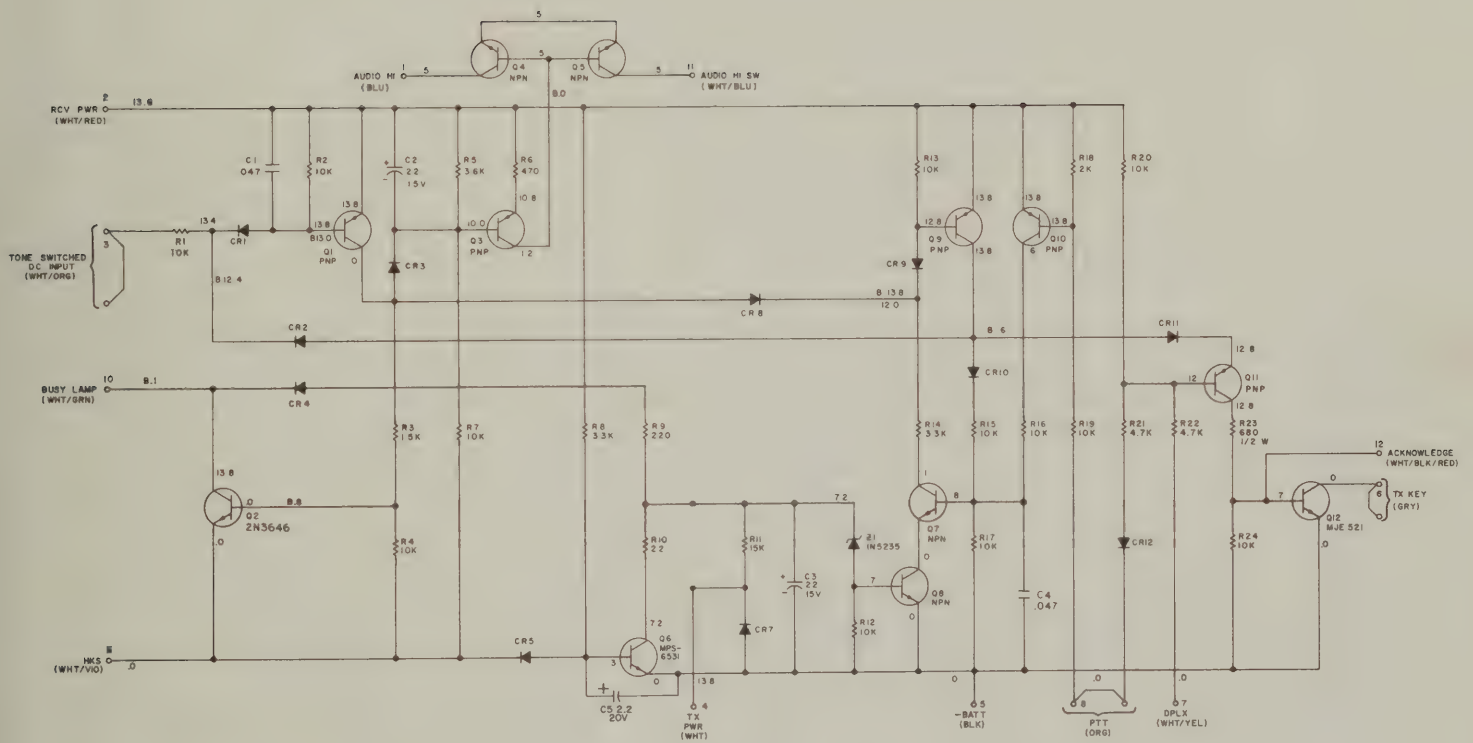
NOTE: PULSE TRAIN SHOWN FOR 7-DIGIT NUMBER 205-9551

Figure 7-4. SACS 7-Digit Correct Code Sequence



23988-001 REV A

Figure 7-5. VP-CR Channel Reverting Board, Schematic Diagram



NOTES UNLESS OTHERWISE SPECIFIED
 1 ALL PNP TRANSISTORS ARE 3PS 4273
 2 ALL NPN TRANSISTORS ARE 3PS 4272
 3 ALL RESISTOR VALUES IN OHMS, 1/4 WATT, 5%
 4 DIODES CR2, 3, 5, 8, ARE IN270
 5 DIODES CR1, 4, 6, 7, 9, 10, 11, 12, ARE TI-55
 6 ALL CAPACITOR VALUES ARE IN MICROFARADS
 7 VOLTAGE MEASUREMENTS ARE MADE WITH A 20,000
 OHM PER VOLT VOLTMETER REFERENCE TO NEGATIVE
 BATTERY MOBILE HANDSET IS OFF HOOK AND KEYING
 CIRCUIT IS OPERATING IN A DUPLEX MODE READINGS
 PREFIXED WITH "B" INDICATE A BUSY LOCK OUT
 CONDITION WITH HANDSET AUDIO AND KEYING
 BLOCKED

Figure 7-6. VP-BY Busy Board, Schematic Diagram

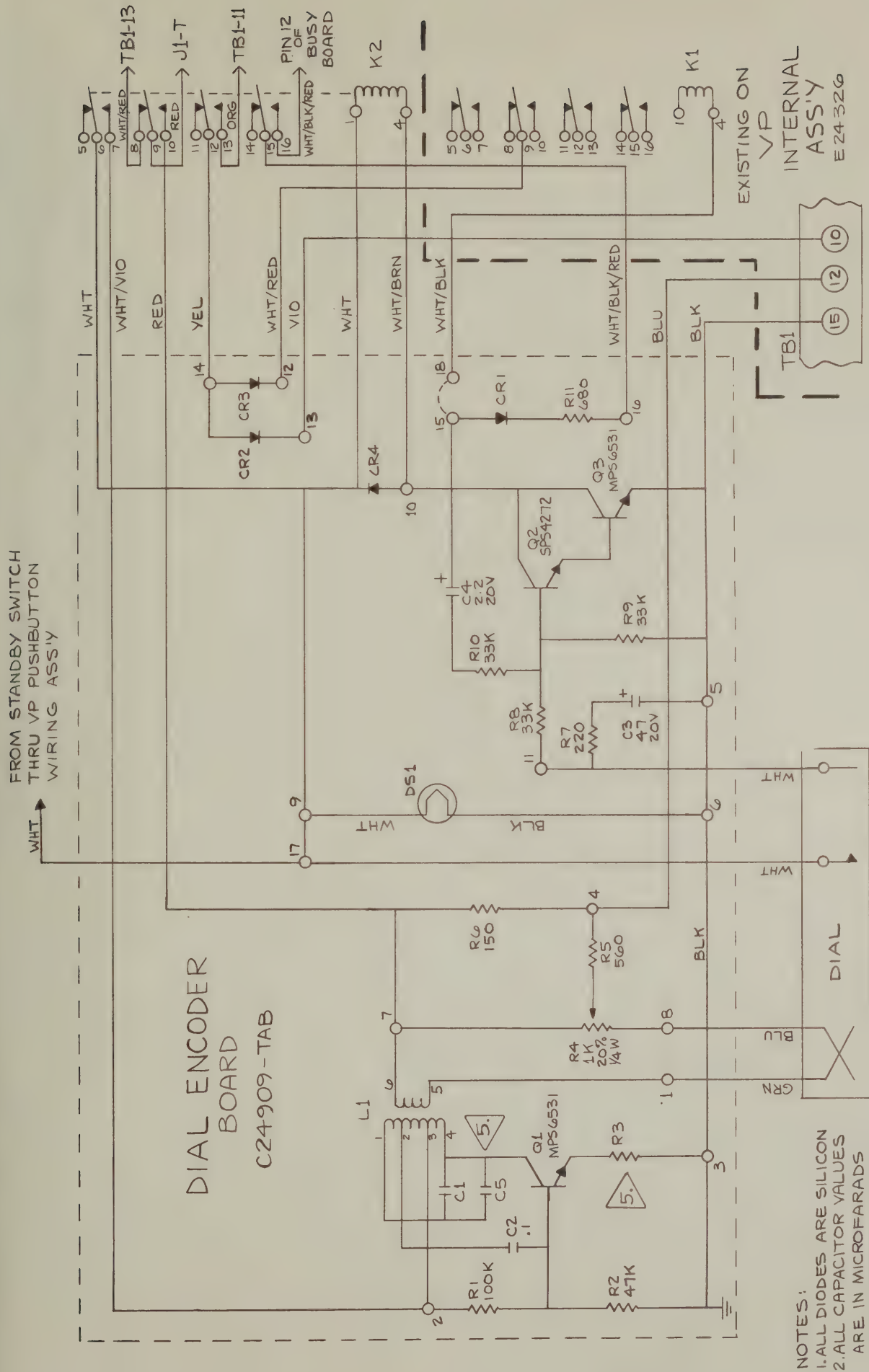


Figure 7.7. VP-DE Dial Encoder Schematic Diagram

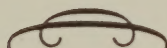
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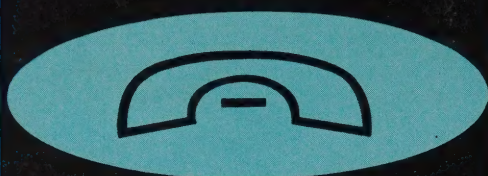
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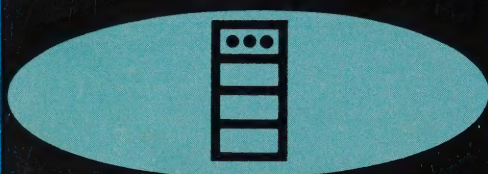
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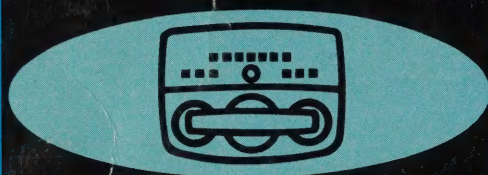
2-Way Station Control



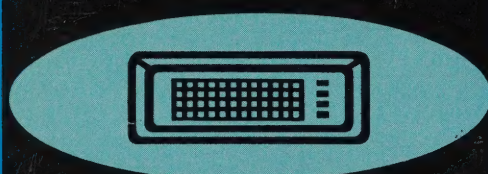
Selective Signaling



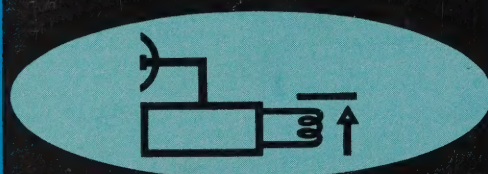
Terminals and Consoles



Mobile Telephone Heads



Alarm and Status Reporting



Remote Actuator Control

